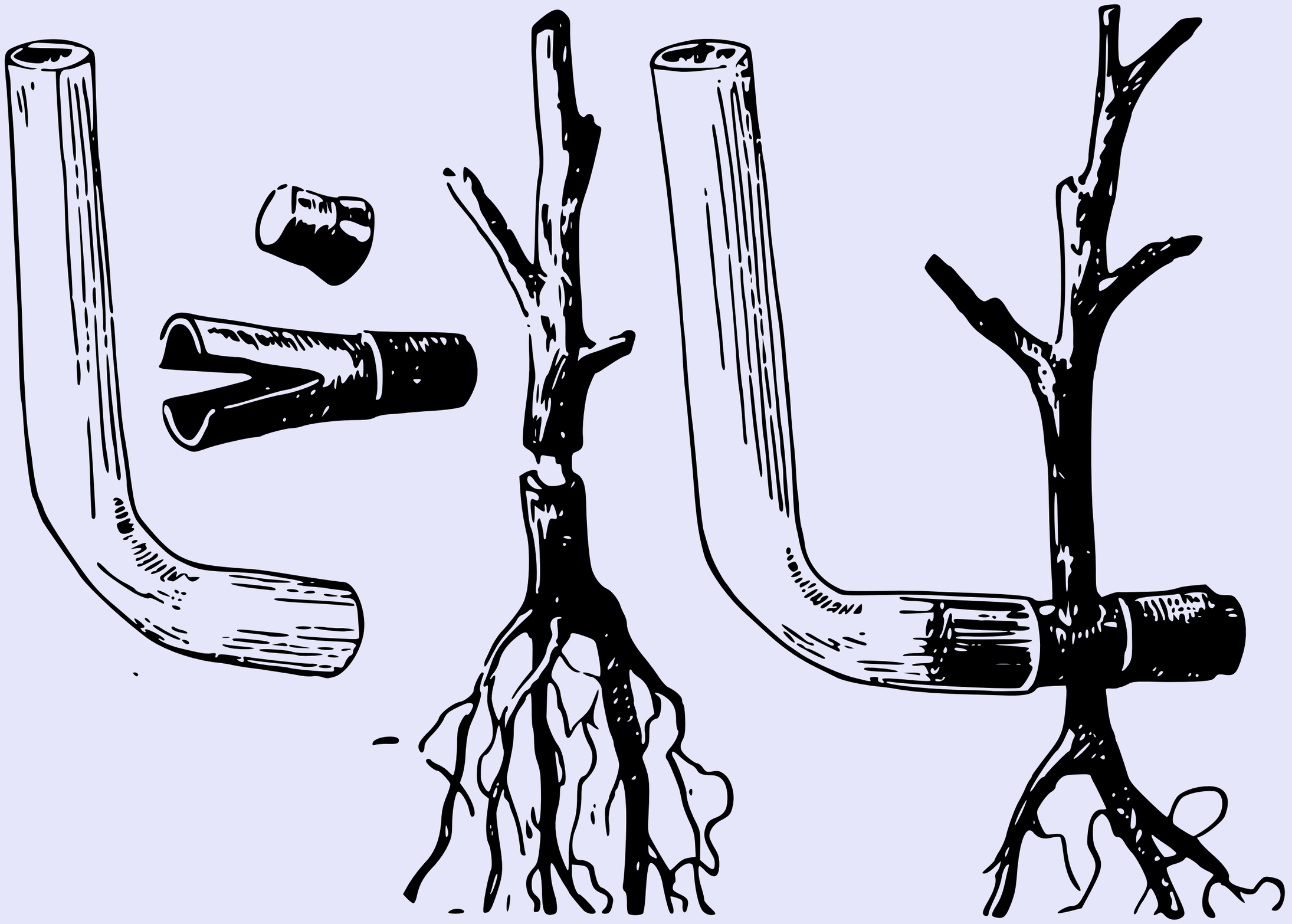
A.N. Bakharev

I. V. MILCHURIN

The Great Remaker Of Nature



FOREIGN LANGUAGES PUBLISHING HOUSE
MOSCOW

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CONTENTS

INTRODUCTION

"We cannot wait for favours from Nature; we must wrest them from her."

(I. MICHURIN)

Ivan Vladimirovich Michurin will be known to history as the founder of a new, revolutionary teaching of the transformation of living nature. His theory helps to create high-yielding, qualitatively superior forms of agricultural plants and productive breeds of domestic animals.

From his youth Michurin was dominated by the lofty idea of producing high-yielding and high-quality varieties of agricultural plants to replace the old, low-yielding, poor varieties and thus to raise the standard of living of the working people.

Peasant farming and particularly horticulture in the central belt of tsarist Russia were in a precarious economic condition. Sixty-five per cent of the total number of peasant holdings were poor peasant households, twenty per cent—middle peasant, and fifteen per cent—kulak (rich peasant) households. Ten million peasant households, ruthlessly exploited by landlords, capitalists, and kulaks, owned between them no more than seventy-five million dessiatins of land, whereas one hundred and forty million

dessiatins of the best land belonged to a handful of landowners and kulaks.

Thirty per cent of the peasant households possessed no horses, thirty-four per cent had no agricultural implements, and fifteen per cent did not do any sowing. What with the inferior quality of the staple grain crop varieties, the result was that fifty-two per cent of the peasant households in tsarist Russia went short of bread.

Michurin saw all this, and being a true patriot he could not remain indifferent to the fate of his motherland and the working people.

In 1934, when the country marked his sixty years' work, Michurin wrote: "The sorry picture of Russian horticulture in those days evoked in me a painfully acute desire to remake all this, to influence the nature of plants in a different way, and this desire was embodied in my own principle, now universally known: *'We cannot wait for favours from Nature; we must wrest them from her.'*

"I made this the basic principle of my work and am guided by it to this day. . . ."

In 1875, in the dark days of tsarist autocracy, Michurin set out to accomplish his idea, using the scanty means he obtained as a railway clerk and odd-job mechanic. The tasks he set himself were as follows:

1. To improve upon the varieties of fruit and berry plants of the central part of Russia and to create new varieties in no way inferior to the best southern types.

2. To introduce into the central part of Russia, in spite of its severe climate, southern fruits, such as apricots, peaches, sweet cherries, grapes, and pears of the Duchesse and Beurré varieties, which could freely winter in those conditions and yield generous crops of fine fruit.

3. To extend the cultivation of fruit plants to new regions of our country where they had not previously been grown—far to the north, to the Urals and Siberia.

Not only did Michurin accomplish these tasks, he

created as well the great transformatory general biological *doctrine of directing the alteration of the nature of agricultural plants to man's best advantage.*

The conditions in which Michurin worked under tsarism for forty-two years were very unfavourable for his scientific and research activities.

In his article *The Dream of My Life*, published in 1934, Michurin wrote: "This had taken many years—and what years they were! Before the Revolution my whole path was strewn with derision, neglect and oblivion.

"Before the Revolution I used to be insulted again and again by the judgments of ignoramuses, who declared all my work to be useless, to be mere 'fancies' and 'nonsense.' The officials from the Department of Agriculture shouted at me: 'You dare not do it!' The official scientists declared my hybrids to be 'illegitimate.' The clergy threatened me: 'Don't commit blasphemy! Don't turn God's garden into a brothel!' "

It was only after the Great October Socialist Revolution that Michurin's materialist teaching was brought to light and assessed at its true value. Only then was the teaching that opened up a broad panorama of further development and prosperity for socialist agriculture spread among the masses and successfully advanced.

Under Soviet rule which placed science at the service of the toiling masses Michurin was for the first time given every opportunity of achieving the aims he had set himself.

The Soviet Government rescued Michurin's work from ruin. It provided him with facilities to pursue his activities on such a scale that in seventeen years of creative work under Soviet rule the scientist achieved far greater results than during the forty-two preceding years. Lenin and Stalin kept track of Michurin's work, inspired him on to new scientific feats and imparted a national scope to his work.

Michurin carefully studied the works of Marx, Engels, Lenin, and Stalin and was guided by them in his activities. This enabled him to rise to a great height of scientific generalization.

"Only on the basis of the teachings of Marx, Engels, Lenin, and Stalin," wrote Michurin, "can science be fully reconstructed. The objective world—Nature—is primary; man is part of Nature, but he must not merely outwardly contemplate this Nature, he can, as Karl Marx said, change it. The philosophy of dialectical materialism is an instrument for changing this objective world; it teaches how to actively influence Nature and how to change it; but only the proletariat is capable of consistently and actively influencing and changing Nature—this is what the teachings of Marx, Engels, Lenin, and Stalin—those unexcelled titanic minds—tell us."

What is required of biological science to help produce the highest yielding forms of agricultural plants and the most productive breeds of domestic animals? Not only must biologists engaged in plant and animal breeding command profound knowledge of the life and development of living organisms, not only must they be selflessly devoted to their vocation; above all, they must be progressive scientists and militant materialists.

Defining the ideological and scientific cast of mind of a naturalist, Lenin wrote: "...unless it stands on a solid philosophical ground no natural science and no materialism can hold its own in the struggle against the onslaught of bourgeois ideas and the restoration of the bourgeois world outlook. In order to hold his own in this struggle and carry it to a victorious finish, the natural scientist must be a modern materialist, a conscious adherent of the materialism which is represented by Marx, i.e., he must be a dialectical materialist."[1]

[1] V. I. Lenin, *Marx-Engels-Marxism*, Eng. ed., Moscow 1953, p. 612.

Michurin was precisely such a naturalist.

He passionately loved his country and his people and selflessly devoted all his life to the elaboration of his new, revolutionary theory. His success gave his country hundreds of extremely valuable varieties of fruit plants, and elevated Soviet biological science in the eyes of the world. He created the science of purposefully raising new forms of plants. The theory and methods of hybridization (sexual and vegetative, intraspecific and distant), the theory and methods of directed training, the theory and methods of artificial selection—such are the major component parts of this science which has been placed at the service of socialism. It was only by viewing all the phenomena of living nature from the standpoint of materialist dialectics that the outstanding biologist was able to accomplish all this.

Michurinist materialist biology enriches the materialist conception of living nature. It brilliantly corroborates the principles of Marxist philosophical materialism that the phenomena and laws of nature are knowable and that our knowledge of living nature, tested by experiment and practice, is authentic knowledge and has the validity of objective truth.

Michurin and his followers contributed to the materialist theory of the development of living matter by proving the correctness of the basic biological law that properties acquired by plants and animals in the process of their development can and must be inherited. They ascertained the decisive role of existing external conditions in the making of hereditary qualities and showed how these qualities can be changed.

Proceeding from a deep understanding of the interconnection and interdependence of phenomena in the unceasing process of their emergence, change and development, Michurin was able scientifically to foresee the useful qualities of a future variety. He proved that in all

their phases of development living organisms are reciprocally connected with, and dependent on, the material conditions of environment.

Michurin's personal traits were a determining factor in this great work of transforming the nature of plants. Michurin's love for his work, his devotion to it, his great patience in the search for scientific truth, the trained eye that he possessed as a naturalist, enabled him to perceive in nature many things that remained hidden from an indifferent observer. Michurin approached every living substance in a creative spirit that was reinforced by scientific integrity and personal modesty.

Michurin's teaching is a further creative development of Darwinism and represents a qualitatively higher stage in the evolution of materialist biology. This is the theory of the revolutionary remaking of living nature for the triumph of communism.

Michurinist agrobiological science is organically linked with the practical experience of collective and state farms. It plays an important part in the work of transforming nature in the boundless spaces of the Soviet land. A creative science, it is itself unquestionably enriched by new discoveries that enhance man's power over the forces of nature and regulate the development of vegetable and animal organisms.

Michurinist breeders, by practising Michurinist methods of scientific acclimatization, are extending far to the north the cultivation of such fruit as peaches, apricots, sweet cherries, nuts, sweet chestnuts, grapes, citrus fruit and some of the most valuable vegetables and melons.

Recalling his fruitless, painful struggle in the gloom of tsarism for a new, transformatory trend in biology and expressing his admiration for the great deeds of socialist construction, Ivan Vladimirovich Michurin wrote:

"The knowledge that we can already intervene in the actions of nature is at present of prime importance for us.

"By intelligent intervention we can now greatly accelerate form-building of new species and bend their constitution in a direction most useful to man."

All of Michurin's works are infused with the idea that man is capable of controlling the development of organisms. Michurinist biology dealt a crushing blow at reactionary idealistic theories. Michurin passionately and consistently denounced reactionary bourgeois science.

A revolutionary in science and devoted son of his people, Michurin took an active part in socialist construction; he was proud of the strength of the collective-farm system, in which he saw a great future for his biological theory.

"I perceive," wrote Michurin, "that the collective-farm system, through which the Communist Party has launched the great task of renovating the land, will lead toiling humanity to real power over the forces of nature.

"The great future of the whole of our natural science lies in collective and state farming."

Michurin's materialist teaching is applied in the work of Soviet biologists engaged in breeding, agronomists, foresters, zootechnicians, and all practical plant breeders. It helps them to achieve new outstanding successes in the further development of natural science and to create new high-yielding varieties of agricultural plants and new highly productive breeds of domestic animals.

I. THE LIFE AND WORK OF I. V. MICHURIN

CHILDHOOD AND YOUTH

Ivan Vladimirovich Michurin was born on October 28, 1855 on the Vershina estate, near the village of Dolgoye (now Michurovka), Pronsk uyezd, Ryazan gubernia.

Michurin's grandfather, Ivan Ivanovich, was a brave and patriotic soldier and fought in all the major battles of the Patriotic War of 1812—Vitebsk, Smolensk, Bobruisk, Borodino and Tarutino, battles that decided the fate of Napoleon's army. In the fighting at Maloyaroslavets, and at Krasnoye village, Ivan Ivanovich showed great military valour and was decorated. After retiring from military service in 1822, he took up horticulture, an occupation which he followed for the rest of his life.

Michurin's father, Vladimir Ivanovich received his education at home and worked for some time at the Tula munitions factory as an arms inspector for the army. After his marriage to a girl of the lower middle class, he handed in his resignation and settled for good on the small Vershina estate that he had received as his share of his father's legacy.

Ivan was the seventh child, but all his brothers and sisters died at an early age. When the boy was still only four years old, his mother Maria Petrovna died, too.

Michurin spent his childhood close to nature on the Vershina estate, situated in the midst of a picturesque typically Russian riverside forest, where there were birch, oak, alder, nut and wild apple trees, flowers and tall undulating grass. The whole locality, with its streams, ravines, hills and woodland glades, abounded in birds of passage and ground game.

His father, Vladimir Ivanovich, was held to be a well-educated man in his neighbourhood. He had a good grounding in various branches of natural science and kept in touch with the Free Economic Society, which was spreading progressive agricultural ideas at that time. Vladimir Ivanovich subscribed regularly to the society's literature and the society sent him grain seed; as well as fruit and vegetable plants. He worked untiringly in his orchard; sowing, planting, grafting and making different experiments with fruit and ornamental plants. Much of his leisure was spent at home, teaching peasant children to read and write.

The fishing, the bird's nests, the forest dens, the new flowerbeds that were constantly appearing on the estate must have raised many a question in the boy's mind that his father, a lively story-teller, was only too ready to answer.

In the evenings Vladimir Ivanovich used to work at his horticultural diary, read, and instructed his son in the subjects he was to take up at school. He taught him the rudiments of astronomy, botany, physics and chemistry, and told him about the wonderful happenings in the life of plants. Tatyana Ivanovna, young Michurin's aunt, a gifted and well-educated woman, who lived nearby at her small estate in the village of Birkinovka, often took part in instructing her nephew; he was a favourite with her and she influenced him greatly.

At an early age the boy displayed a deep-seated inclination for plant growing. It was his favourite occupation

to collect and plant seeds and to tend the fruit, vegetable and ornamental plants. At the age of eight under his father's guidance, he had already mastered many methods of grafting.

"... As long as I can remember myself," Michurin wrote in his autobiography, "I was always completely engrossed in the work of cultivating plants. And my enthusiasm was so strong that I scarcely noticed many other details in life; it is as if they all passed me by, hardly leaving any impression on my mind."

While studying at home, and later at the Pronsk elementary school, Michurin devoted all his free time, especially during the holidays, to botany or to work in the orchard or the bee-garden.

After finishing the Pronsk school in 1869, Ivan began preparing for his entrance examinations at a Petersburg college. But just at that time, when the boy was dreaming of his new life in Petersburg and his future work as a naturalist, misfortune overtook him.

His father, a comparatively young man, fell seriously ill. Vladimir Ivanovich had never liked business affairs and had devoted all his time to experimental gardening. Now he found himself heavily in debt and obliged to sell his estate to make good his obligations. The ruin of his father brought a radical change in Ivan's life. Deprived of any opportunity of receiving higher education, he turned to his aunt and uncle Lev Ivanovich, who helped him to enter the gymnasium at Ryazan. Only a few months passed, however, before he was expelled for "disrespect to his superiors." The fact was that when meeting the headmaster of the gymnasium in the street one day, Ivan had not taken off his cap because of the bitter frost. But the real cause of his expulsion was a quarrel between the headmaster and Lev Ivanovich, who had refused to pay a bribe for his nephew's enrollment in the gymnasium. There was no one to intercede for the unfortunate boy,

and after his expulsion for "disrespect" he had no chance of entering any other educational establishment. Besides, there was no way of getting money for further studies. And so, in 1872, Michurin had to take a job as clerk at the Kozlov goods depot on the Ryazan-Kozlov Railway, for a wage of 12 rubles a month. He lodged in the hut of Elena Vasilyevna Balakireva, a shoemaker's widow, in the railwaymen's settlement at Yamskaya.

IN THE FETTERS OF TSARISM

In 1874, Michurin was promoted to the post of cashier and later to that of assistant station master.

This somewhat improved his position and enabled him to devote his time systematically to self-education.

During that period Michurin was keenly interested in railway technical problems and worked hard studying physics, theoretical mechanics and electricity. He was especially persevering in chemistry, and Mendeleyev's *Principles of Chemistry* became his constant companion.

Michurin was never seen idling about. He always busied himself either with the telegraph and telephone sets in the station superintendent's office, or in the signal box, the pump-house or on one of the locomotives. On his days off he repaired and tested telephone and signal sets, control and measuring instruments, such as pressure gauges, barometers and watches, everywhere showing a passion for invention, for improving things and producing new ones. Many years later, in 1930, recollecting his experiences as a railway mechanic, Michurin wrote: "I attempted to improve all that came my way: I have worked in various branches of mechanics and electrical engineering, perfected various instruments. . . ."

Michurin constantly mingled with the workers, and his best friends were mechanic Teshchin, machinist Sevastyanov, turner Kolosov, watchmaker Kalugin and office

clerk Yershov. His democratic views were shaped under the influence of these advanced workers.

In 1874, Michurin married Alexandra Vasilyevna Petrushina, a worker's daughter, who became his devoted friend and helper. She shared with him all the hardships, privations and adversities of his difficult life of a lone research worker during the dark years of tsarism. Later on, the Michurin family was joined by Michurin's sister-in-law Anastasya Vasilyevna Petrushina, and his wife's niece Alexandra Semenovna Platenkina. Until the Great October Socialist Revolution they were his only assistants.

Although he worked hard to increase his knowledge of mechanics and other technical sciences, Michurin realized that his place in life was not there, at the railway station, but in the orchard, transforming living nature. And following his urge, he rented in 1875 a small neglected orchard near his lodging. There he planted the seeds of the best southern and local varieties of apple, pear, sour cherry, plum, apricot and other fruit plants, with the aim of producing new, improved types suitable for the central belt of Russia.

With all the zeal of a novice Michurin devoted himself to planting the seeds of fruit plants and to selecting the most valuable of the seedlings. This required extensive knowledge of the life of plants as well as financial means for the purchase of seeds, implements, special equipment, and for building a shed for the storage of southern plants in winter. Michurin's financial position became particularly difficult when for boldly criticizing the misconduct of the station master, he was dismissed from his post and transferred to Ryazhsk as cashier. Six months later, P. Khrennikov, the new Kozlov station master, helped Michurin to get a job as a railway watchmaker on the Kozlov-Ryazan, Bogoyavlensk-Lebedyan lines. Back in Kozlov, Michurin started a watchmaker's shop in his little

I. V. Michurin at five

I. V. Michurin and A. S. Tikhonova, an assistant, working in the orchard

two-room flat, in order to earn money for experimenting on fruit plants. In his free time he worked in the shop repairing watches, barometers, pressure gauges, bicycles, primus-stoves and sewing machines.

In this way Michurin lived for thirteen years. Two days of the week he was at home, either in the shop where he spent his time drilling, grinding and polishing; or in the nursery, digging, sowing, planting and grafting. At night, drawing his information from magazine articles and reviews by naturalists, he studied botany, the anatomy and physiology of fruit plants, and the geographical distribution of wild fruit and berries.

In 1887, Michurin wrote in his diary: "The buying of land is out of the question for another five years; expenses must be cut to the limit."

A tangible expression of this "limit" was meatless cabbage soup, a "two-kopek package of tea for the pot," boiled potatoes, and three pounds of brown bread—the total daily ration of the naturalist's family.

Recalling that period Michurin tells us that often, upon returning from Ryazan or Ryazhsk, he had for supper nothing but *tyurya*, a cold soup consisting of rye bread and onions cut up in salted water.

Hard work, constant poverty, malnutrition, sleepless nights and the metal dust from the bench in the shop undermined Michurin's health. In the spring of 1887, he began to cough up blood. Yershov, a friend of Michurin's, a jaunty and cheerful clerk at the Kozlov-Voronezhsky goods depot, advised him to move away for the whole summer to the Khorek oak woods on the outskirts of the town. On the fringe of the woods towered a windmill belonging to one Gorelov. The only accommodation in the neighbourhood consisted of a miller's dilapidated little cottage, which he let for the summer to anyone willing to take it.

After getting leave of absence from his office, Michurin

moved with his family to Khorek. The pure air, the sun, milk fresh from the cow, walks in the forest, meadows and fields, helped Ivan Vladimirovich to recover his health. But it was in the development of his scientific ideas that the influence of nature proved especially beneficial.

It was there, in close communion with nature, that his idea of improving fruit plants in Central Russia came to full maturity.

In embarking upon this great enterprise, however, Michurin was unable to find any scientific data on the cultivation of new varieties. Prior to Michurin no such science had existed. No wonder Michurin was carried away by the fallacious theory of A. K. Grell, a Moscow fruit-grower, who claimed that southern plants could be acclimatized in the severe climatic conditions of Moscow, by taking cuttings of southern thermophilic varieties of fruit plants and grafting them on Russian cold-resistant fruit trees or two-year-old wildings. This theory claimed that under the influence of the frost-hardy northerners, the southerners would adapt themselves to the severe climate.

Putting his faith in Grell, Michurin spent all his meagre savings and ran into debt. Nevertheless, he managed to stock his rented orchard with a collection of 600 varieties of fruit and berry plants of southern and western origin,—a vast collection by the standards of that time. But the whole collection of plants, made in the teeth of so many difficulties, perished from frost within five years. Still Michurin did not lose heart. By carefully analyzing the works of Grell, he discovered that Grell was mistaken. Grell had been wrong to take cuttings from southern fruit trees (and not only southern) that had undergone all the phases of their development and had perhaps borne fruit for many years. The organisms of such fruit plants cannot adapt themselves to new unaccustomed conditions

of life. Realizing that Grell's method of acclimatization was faulty, Michurin soon started breeding new varieties of fruit and berry plants by sowing seeds obtained through hybridization (crossing). Several years elapsed, and Michurin originated new varieties of fruit plants, thus scientifically proving that *the varietal nature of an agricultural plant is formed in the very early phases of its development, and at this stage the plant is more susceptible of directed training*. Even then Michurin had understood that phasic development is irreversible.

In 1888, in spite of many financial difficulties, Michurin succeeded in buying a small piece of land six *versts* from Kozlov, near Turmasovo settlement. In the spring of 1889, he gave up his work on the railway and transplanted the whole of his nursery.

By that time Michurin had gained great experience in producing new varieties of fruit plants. From 1885 to 1889 he bred new varieties of sour cherries: Griotte Grushevidny (pear-like), Tradurc, Michurin Plodorodnaya, and the remarkable cherry variety Krasa Severa (Beauty of the North), obtained by crossing the Vladimirskaya sour cherry with the Crimean Winkler White sweet cherry.

Michurin saw that hybridization and directed training of hybrid seedlings was the scientifically and methodically correct line of action. And now he was in a position to turn to broader experiments for the realization of his great ideas.

Though working at his own risk, and his own expense, Michurin nevertheless considered his work a matter of great national importance, and not a private enterprise. Michurin wanted first-hand information on the state of gardening in the central part of Russia, and for this purpose he spent the summer of 1889 touring all the horticultural districts he was interested in. He inspected orchards in Voronezh, Orel and Kursk gubernias, in

south-eastern Byelorussia, in the northern parts of Kiev and Kharkov gubernias, in the North-Donets districts, in the southern uyezds of Tambov and Penza gubernias, as well as orchards in the Middle Volga country—Saratov, Samara and Simbirsk gubernias—and those in the south-western uyezds of Kazan gubernia, Mordovia, and Moscow and Ryazan gubernias.

What did Michurin see in the orchards of those areas of our country in the late nineties of the past century?

He observed horticulture not in two or three provinces but in the whole of Central Russia, horticulture in all its aspects—assortment, technical facilities, and economics. Everything he saw confirmed, above all, the sad state of peasant horticulture. The peasant orchards were very small; there were only a few fruit trees in each household, and even such households were rare.

The assortment of apples and pears was everywhere predominantly of the summer varieties and these sold for a trifle. With the exception of some types of Antonovka, there were very few varieties of autumn apples, this being equally true of winter varieties. Winter varieties of pears were non-existent. Most of the cherries and plums were of the semi-cultivated type.

Peasant gardening was in a miserable state, and was ruthlessly exploited by kulak tradesmen. They would buy up at ridiculously low prices all the fresh and dried pears, apples, cherries and plums in Voronezh and Kursk gubernias, in the Donbas, in the northern provinces of the Ukraine and throughout the Middle Volga country, and ship them to the metropolitan markets.

It was the system of private ownership in agriculture, the lack of legal and economic rights, the ignorance, oppression and almost continuous starvation of the peasants that put such a heavy brake on the progress not only of horticulture, but of all Russian agriculture. It was the result of exploitation by the landlords and capitalists.

Only the landlords, the monasteries and the rich kulaks were able to cultivate commercial orchards.

It was for this reason that a considerable part of the Russian fruit trade depended on imports from the south and West European countries. This led to wastage of the national wealth, since the imported fruit—pears, grapes, lemons, oranges, and winter varieties of apples—was paid for recklessly in gold.

The lack of good training facilities was a characteristic feature of horticulture in tsarist Russia. Until 1915 (when the chair of fruit growing was founded at the Petrovsky, now Timiryazev, Academy of Agriculture in Moscow) Russia had not a single establishment of higher learning in this branch of agriculture.

Both the theory and practice of Russian horticulture were in urgent need of revolutionary transformation. It was to this task that Michurin devoted all his scientific research activities.

After ten years of intensive work in hybridization and directed training of hybrids, Michurin produced the following valuable varieties: apple—six-hundred-gram Antonovka, Reinette Sakharny (Sugar Reinette), Reinette Bergamotte (produced by vegetative hybridization of apple and pear), Slavyanka, and Truvor; pear—Kozlov Beurré; plum—Reine Claude Zolotisty (Golden), Reine Claude Shelonsky, Tyorn Sladky (Sweet Blackthorn), and others. This considerably enriched the horticulture of the central belt of Russia with varieties of high-yielding and superior quality.

Michurin published articles about his new varieties, and advocated his new progressive ideas in the magazines *Vestnik Sadovodstva*, *Plodovodstvo*, *Progressivnoye Sadovodstvo i Ogorodnichestvo*, *Sadovod*, and *Sad i Ogorod*, as well as in the catalogues of his nursery, in leaflets and memoranda. He pointed out the need to break away from dependence upon foreign countries, to unite the national

efforts of Russian gardeners and sum up and implement their experience. Michurin used to say that it was necessary to originate home-grown varieties suitable for the soil and climatic conditions of every locality in Russia.

In 1900, Michurin decided to move his Turmasov nursery, as the soil there did not answer the requirements of directed training of hybrids. And Michurin moved his nursery for the third time—to a new place with a more suitable soil, near the village of Donskoye in the valley of the river Lesnoy Voronezh, not far from the town.

By 1905 Michurin had produced numerous fine varieties of apples, pears, and sour cherries. For the first time in the history of fruit growing, frost-resistant varieties of sweet cherries, almonds, grapes, cigarette tobacco, attar rose and other plants were cultivated in Central Russia.

In October, 1905, I. V. Michurin reached the age of 50. His selection methods were already taking shape in a new general biological theory that was a further development of Darwin's materialist doctrine. Of course, not only did the tsarist government and official biological science fail to recognize Michurin, but they even seemed not to take any notice of him. No wonder that Michurin's new varieties gained little popularity in his own country.

Michurin feared that his work of discovery might be lost for ever. On the advice and at the urgent request of Marfin, land inspector of the Tambov gubernia, he sent several memoranda to the Department of Agriculture "... in which I tried to explain the vast importance and the necessity of improving and increasing native varieties of fruit-bearing plants by raising local varieties from seeds. Nothing came of these memoranda."

His cherished aim was to open a school to teach methods of plant breeding based on his achievements, which "... would be of incalculable benefit to our country." He repeatedly applied to the Department for permission to open such a school, but his applications remained

unanswered. It was his plan that the school should be attended by children of workers and poor peasants, and by homeless orphans. Instruction was to be based on a materialist conception of the development of nature and of man's creative function in regulating the evolution of the vegetable organism. Indignant at the way the tsarist higher and secondary schools crammed the minds of their students with reactionary idealistic rubbish of the Mendel-Weismann brand, Michurin attempted to found a school that would be fully protected from any reactionary influence and would be of incalculable benefit to our country. But that was the last thing the tsarist government wanted.

In 1911, summing up the results of 33 years of scientific research in a major work, entitled *Production of New Cultivated Varieties of Fruit Trees and Berry Shrubs from Seed*, Michurin gave the following account of the difficult position of a progressive scientist under the decadent tsarist system:

"For thirty-three years I have had to toil and moil on wretched patches of land, to deny myself utter necessities, to tremble over every farthing spent, and to try to recover it, to win it back, as quickly as possible, so that I might be able the following year, one way or another, however inadequately, to train an additional dozen plants, sometimes, with bitterness at heart, destroying valuable specimens solely because there was no available space for other plants.... And what is the result? After thirty-three years of labour, after having produced many evidently valuable new varieties of fruit plants—practically no interest or attention on the part of Society,[1] and still less on the part of the government, in spite of my repeated applications and petitions. And as to material support,

[1] Michurin had in mind the Russian Society of Fruit-Grower of which he was a member.—*Ed.*

the less said the better—that you can never expect for a useful cause in Russia. And so, in the end, the work is going to rack and ruin, the nursery is run-down and neglected, two-thirds of the new varieties have either perished, lost for lack of proper care and necessary space, or have been distributed among various purchasers in Russia and abroad, whence they will return to us under different names. Health and strength are failing, and, willy-nilly, I shall have to part with the vocation I love and, although gradually (for many of the plants are only entering on their bearing age), wind up the work altogether."

Michurin shared the fate of many fine sons of Russia, fighters for the progress of science and technical knowledge, creators of culture and art, who could not carry out their great ideas under tsarism.

In the summer of 1915, when cholera raged in Kozlov, a young working girl, Vera Logunova, fell ill at the nursery. Michurin's tactful and kind wife, Alexandra Vasilyevna, caught the disease herself while looking after the sick girl. Vera Logunova's young constitution carried her through, but Alexandra Vasilyevna paid the price with her life.

That was the most tragic period for Michurin. Sixty years of life and forty years of scientific work had already passed. And throughout those forty years nothing but appalling poverty, petty economizing in everyday life, neglect by official biological science, and oppression and derision by the tsarist officials. Could anything be more miserable and humiliating?

The death of Alexandra Vasilyevna was a heavy blow to Michurin. He had reached an old age and his whole work was threatened by non-recognition. But Michurin's great idea, his noble aim and powerful will proved stronger than all the dark forces of tsarism, and stronger than his personal grief.

Peppin Shafranny
diminished

THE SOVIET PERIOD

After the victory of the Great October Socialist Revolution Michurin went to the newly organized District Department of Agriculture, and said: "I want to work for the Soviet power."

That day marked the beginning of a new period in Michurin's life and work, a period that culminated in brilliant achievement.

In spite of the economic ravages of World War I and the Civil War which had just broken out, the young Soviet State provided Michurin with the necessary staff, funds and materials. With renewed energy he set about extending his scientific work.

Michurin actively assisted the People's Commissariat of Agriculture in organizing Soviet agronomy. He drafted plans for developing horticulture and wrote articles propagating his general biological doctrine of directed alteration of agricultural plants in a way most desirable to man. Michurin called upon agronomists to promote plant and animal selection on a comprehensive basis. He attended local agricultural conferences and laid before the public his vast experience in raising crop yields. Michurin actively participated in carrying out the measures of the Communist Party and the Soviet Government to combat drought.

In 1920, Michurin engaged I. S. Gorshkov, an enthusiastic young agronomist, as his chief assistant and started preparing for the all-round extension and development of his scientific research work.

By that time Michurin had already raised 154 new varieties of fruit and berry plants: 45 varieties of apples, 20 varieties of pears, 13—sour cherries, 15 plums, among them three of the Reine Claude type (round), 6 sweet cherries, 9 apricots, 2 almonds, 8 grapes, 2 quince, 5 Actinidia, 1 nut (filbert), 3 mountain ash, 6 currant,

1 gooseberry, 4 blackberry, 1 melon, 1 tomato, as well as many other varieties that were of great economic value to the country.

All these varieties had to be tested and propagated in different soil and climatic conditions before the best of them could be introduced at collective and state farms which were then being organized in the Soviet Union.

With a view to propagating Michurin varieties on a large scale, I. S. Gorshkov, actively supported by the Kozlov District Executive Committee, established in January 1921 a new branch of the nursery and was the first to use Michurin's method in cultivating new varieties.

Soon the nursery began to attract the attention of thousands of Soviet farmers, representatives of collective and state farms, educational and experimental institutions, and schools.

Mikhail Ivanovich Kalinin, President of the Central Executive Committee visited Michurin in the summer of 1922.

He had a long conversation with the scientist, who showed him the nursery. After his visit, M. I. Kalinin sent Michurin a parcel and a letter which said:

"Dear Ivan Vladimirovich,

I am sending you a little parcel as a remembrance.

I hope you will not consider this an act of favour on the part of one in high office.

It is simply my sincere wish in some way to express my respect and sympathy for you and your work.

With sincerest greetings, *M. Kalinin*

December 15, 1922"

The end of 1922 was marked by a great event in Michurinist biological science. Lenin stressed the great

importance of Michurin's work. In *Dates in the Life and Work of V. I. Lenin* (August, 1921—January, 1924), we find the following entry: "November 18, (1922). V. I. Lenin inquires about the work and experiments of I. V. Michurin."

On that day, the Tambov Executive Committee received the following telegram from the Council of People's Commissars:

"Experiments in raising new varieties of cultivated plants are of enormous importance for the country. Send forthwith a report on the experiments and work of Michurin, of the Kozlov district, for submission to the Chairman of the Council of People's Commissars Comrade Lenin. Confirm execution of this instruction."

There is another significant entry.

"December 5 (1922). Lenin charges the Chief of the Chancellery of the Council of People's Commissars to inquire from the People's Commissariat of Agriculture about measures taken to assist I. V. Michurin."

Michurin was discovered for our people and for science by Lenin.

In 1923, the First All-Union Agricultural Exhibition was opened in Moscow. Michurin had no taste for the pre-revolutionary exhibitions organized by noblemen landlords under the auspices of various high-born personages. But he warmly welcomed Soviet agricultural and industrial exhibitions that were to help develop the country's national economy and improve the well-being of the working people. With great enthusiasm he and his assistant I. S. Gorshkov prepared for a national demonstration of their achievements.

The excellent seedlings, and the fine Michurin fruits and berries greatly impressed both exhibitors and visitors at the exhibition. The committee of experts conferred on Michurin the highest award, a diploma of the Central Executive Committee of the U.S.S.R.

By decree of the Council of People's Commissars of the R.S.F.S.R., dated November 20, 1923, the Michurin nursery was recognized as being of state importance. It was noted that the nursery had advanced to the first rank among the scientific research institutions of the Soviet Union. The nursery was allocated considerable funds, laboratory equipment, and more land, and its staff was increased.

On October 25, 1925, by decision of the Communist Party and the Soviet Government, a public celebration was held in Kozlov to mark the fiftieth anniversary of Michurin's work. Representatives of the Party, the Government, the press, scientific and education establishments, trade unions, the Soviet Army, and collective farmers took part.

M. I. Kalinin wrote to the honoured scientist:

"My Dear Ivan Vladimirovich,

It was to my great regret that I could not personally convey to you my feelings of profound respect and esteem.

Allow me then, at least in writing, to congratulate you most sincerely and share with you the joy at the results of your half-century of work.

It is not for me to stress what a valuable contribution those results have been to the store of our knowledge and practical work in agriculture. The further our Union develops and strengthens, the clearer and greater will be the importance acquired by your achievements in the entire system of the national economic life of the Union.

A better future for the toiling people depends not only on a suitable state structure, but on commensurate scientific achievement as well. I have no doubt whatever that the working people will duly appreciate your work of fifty years that has been so tremendously useful to the nation.

I wish you most cordially further successes in mastering the forces of nature and in making them serve man to a still greater extent.

Very respectfully yours,
M. Kalinin

The Kremlin, October 30, 1925"

Maria Ilyinichna Ulyanova, Lenin's sister, wrote to Ivan Vladimirovich on behalf of the editorial board of *Pravda*:

"Dear Ivan Vladimirovich,

On the day of the golden jubilee of your work in renovating the land, *Pravda* sends you its warmest greetings. May you preserve your strength and vigour for many years to come; by your achievements and victories over nature may you help the peasant economy to progress along the path mapped out by Lenin."

For his outstanding fifty years of highly valuable work in the cultivation of new, improved varieties of fruit and berry plants, Michurin was awarded the order of the Red Banner of Labour by the Central Executive Committee of the U.S.S.R., as well as a life pension.

As a result of the general extension, the nursery now contained over 30,000 new hybrid varieties of apples, pears, sour cherries, sweet cherries, plums, almonds, grapes, nuts, raspberries, blackberries, gooseberries, currants, wild strawberries, and other fruit and berry plants raised by Michurin and his assistants in the Soviet period of his activities.

In 1927, I. S. Gorshkov and the film producer B. Svetozarov made a film *The South in Tambov* which told about the transformation of plant organisms and about Michurin's practical achievements. That film was an outstanding event in the history of Soviet biological science.

In 1929, the Soviet Government realized Michurin's most cherished dream. A Selection Technical School, the first in the country, was organized at the nursery, which by then had become known as the Michurin Selection and Genetics Station.

Before the school was opened the Soviet Government satisfied another life-long wish of Michurin's: the *Novaya Derevnya* Publishing House put out his work *The Results of Fifty Years of Work*, which contained an outline of the principles of his general biological doctrine.

On February 20, 1930, M. I. Kalinin, President of the Central Executive Committee of the U.S.S.R. and of the All-Russian Central Executive Committee, again visited Michurin. He made a careful study of the latest work and achievements of Ivan Vladimirovich, and solicitously inquired after his health and the needs of the Station.

By the efforts of the Communist Party and the Soviet people, our country achieved great successes in socialist construction. The Soviet people set about implementing the first Five-Year Plan for the transformation of our country from an agrarian, backward, economically and technically weak country into an advanced industrial power. The great collective-farm movement was started. All this created a new unprecedented social-economic and cultural-technical base for the extensive application of science in all the branches of the national economy.

It was only a planned, large-scale socialist agriculture rallying millions of peasants in the collective farms and armed with the most advanced technique that could put into practice the achievements of science, including Michurin's great innovatory teaching of controlling the development of vegetable and animal organisms.

To develop Michurin's doctrine and put his practical achievements to further use, the Communist Party and

the Soviet Government founded in 1931 a number of establishments of nation-wide importance. Among them were the Institute of Education, Experiment and Production,[1] comprising a fruit farm of over 3,500 hectares; the Central Scientific Research Institute of Northern Horticulture;[2] the Institute of Fruit and Vegetable Growing (a higher educational establishment); a technical school; a workers' faculty; a children's agricultural centre; an experimental school, etc.

The Selection and Genetics Station of Fruit and Berry Cultures (the former nursery) founded and directed by I. V. Michurin expanded greatly during that period. After 1931, the town of Kozlov (later Michurinsk) became an important centre of scientific and commercial horticulture. Michurin's activities assumed unprecedented scope, and his life changed greatly. Soviet realities surpassed his most ardent hopes. During tsarism Michurin was an outcast, a lonely man. After the Great October Socialist Revolution he reached a high position in science; he was given everything he needed for further investigating living nature; he became a widely-recognized breeder of new forms of plants.

On June 7, 1931, the Presidium of the Central Executive Committee of the U.S.S.R. decorated Michurin with the Order of Lenin "for outstanding services in originating new forms of plants which are of paramount significance for the development of fruit growing, and for special work of state importance."

This high award was presented to Michurin at the jubilee plenary sitting of the Kozlov Town Soviet on August 16, 1931. In a speech of gratitude the great remaker of nature said:

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[1] Now reorganized into a state fruit farm. The establishments that formed part of it have become independent.

[2] Now the Scientific Research Institute of the Fruit and Berry Industry of the R.S.F.S.R.

"Comrades, the signal honour which the Workers' and Peasants' Government has bestowed upon me by awarding me the Order of Lenin fills me with enthusiasm and an aspiration to continue with still greater energy the work I began fifty-seven years ago of cultivating new, highly productive varieties of fruit and berry plants, of carrying out Vladimir Ilyich Lenin's injunctions to rejuvenate the land.

"I express my sincere gratitude to the Government of the Land of Soviets and firmly believe that the varieties I have raised will be immensely popular among and of great use to the working people. I believe that, along with my achievements, the principles and methods on which I based my work of developing fruit growing will be deeply rooted in the minds of the working people."

The plenum submitted to the Presidium of the Central Executive Committee of the U.S.S.R. a petition to rename the town of Kozlov into Michurinsk. On May 18, 1932, the Presidium of the Central Executive Committee of the U.S.S.R. granted this request.

A NEW TYPE OF SCIENTIST

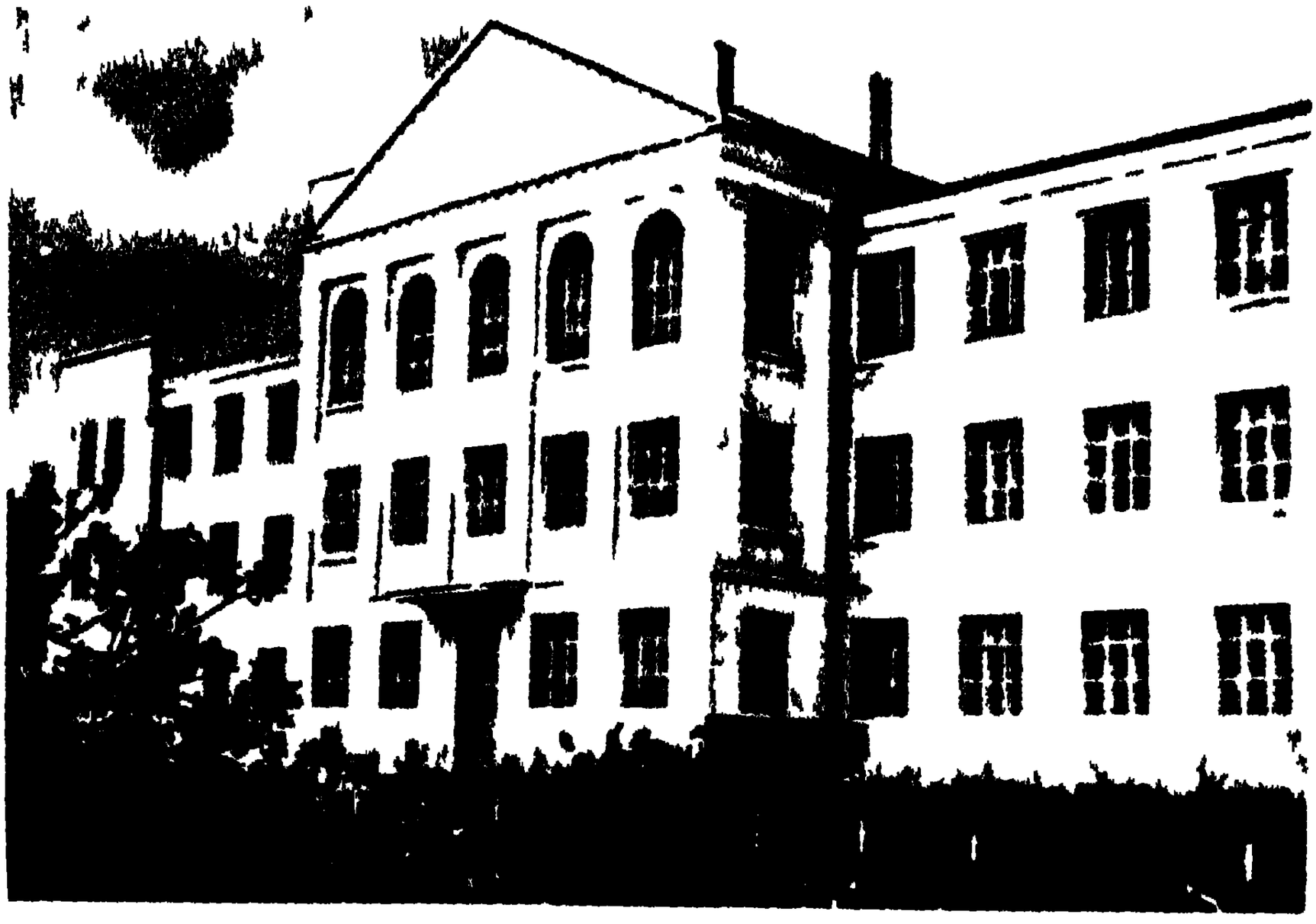
Ivan Vladimirovich Michurin's life and work is a great feat of labour and science, an example of selfless, patriotic service to one's people and country.

Michurin patriotically rejoiced and took pride in the scientific and practical achievements of the nursery he had founded and which was now steadily enriching the Soviet State with progressive biological ideas and new superior varieties of plants.

Michurin was quick to notice every event that promised the country greater prosperity. On learning in 1931 that S. S. Zaretsky had found a new important rubber-bearing plant, tau-saghyz, in the Kara-Tau Mountains, Kazakhstan, Michurin at once arrived at the practical

Michurin in his study (1926)

A wing of the Michurin Central Genetics Laboratory



The Michurin Scientific Research Institute of Fruit and Berry Growing, Michurinsk

conclusion that the cultivation of this valuable plant must be extended to the central part of Russia, nearer to the industrial centres. He obtained seeds of the plant and started experimenting on them under Michurinsk conditions.

Now seventy-seven years old, Michurin responded with the fervour of a young man to all the measures the Party and the Government took for raising new food and industrial crops, such as cotton, essential oil plants, cork oak, tung and citrus trees, rice, tea, etc. He gave his advice on these matters to delegations that came to see him from the Moscow Soviet, the Donbas and Transcaucasia. Workers, collective farmers, and Komsomol[1] members applied for his aid on questions concerning horticulture and market-gardening. He wrote appeals and gave advice on the most diverse questions of selecting and cultivating fruit, vegetables and industrial crops. He insistently demanded from the People's Commissariat of Agriculture an increased production of garden machines and implements, as well as of chemicals to combat pests.

Considering the introduction of new cultured plant varieties a matter of great national importance, Michurin applied his inexhaustible initiative to develop home plant growing and to make it thrive.

Before the Great October Socialist Revolution, Michurin had depended on the haphazard services of naturalists, sailors, hunters, and trappers to bring him from almost all the continents of the world the plants and seeds he needed for hybridization with local or southern varieties. Extensive hybridization and research work could not, however, be carried out on the basis of a chance inflow of plant material. In Soviet times Michurin saw the realization of his dream of having special Government expeditions sent out to search for new forms of plants

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[1] Komsomol—Leninist Young Communist League.—*Ed.*

in the little-explored territories of the U.S.S.R., particularly in the Far East regions.

"Never and nowhere throughout the history of horticulture," Michurin wrote in 1932 in his address *To Horticulturists, Shock Workers and Rationalizers, to Komsomol and Collective-Farm Youth*, "has the breeding of fruit and berry plants been conducted so correctly and on so extensive a scale as in the U.S.S.R. at the present time.

"The Bolshevik Party and the Soviet Government have not only charted the course to be followed by plant breeding, but have assured its far-reaching development by opening wide to workers and peasants the doors of educational establishments, giving them free access to science, providing every opportunity for obtaining seed from remote areas of the U.S.S.R. as well as from abroad and for exchanging seeds. With unlimited scope and the vast potentialities for their work, plant breeders should now strive persistently to produce high-yielding, early-ripening and weather-hardy fruit and berry plants of outstanding qualities."

In his address Michurin called upon the Soviet youth to introduce a maximum number of new plants for cultivation in orchards and gardens, to establish close contact with the places where these plants grow, and to arrange a regular exchange of seeds.

Michurin suggested that special youth expeditions be organized to procure new plants in forests, mountains, steppes and marshes under the slogan "All the best specimens should go to the collective- and state-farm field." He recommended that prizes be awarded on the principle: "A prize for the best variety, successful experimentation, and for a newly-found useful plant."

In 1931, I. V. Michurin personally organized a Komsomol expedition to the Ussuri-Amur Taiga. With patience and understanding he perseveringly taught the enthusiastic Komsomol members leaving with the expedition where

to look for plants that interested him, how to preserve their seeds or roots, and how to prepare them for shipment to Michurinsk. He taught them the necessity of appreciating the native store of knowledge of plant life in the taiga, showed them how to collect a herbarium, to keep a journal and diary of the expedition, etc.

The expedition brought Michurin some 200 specimens of seeds, cuttings, and living plants (grape, lime, actinidia, apple, pear, raspberry, Vaccinium uliginosum, currant, gooseberry, and many other valuable Far Eastern forms of plants).

Later, Michurin repeatedly sent expeditions of workers of the Central Genetics Laboratory and of the Scientific Research Institute to the mountainous districts of the Caucasus, to Central Asia, the Altai, and to the Far East. These expeditions brought back a number of valuable varieties of fruit and berry plants for breeding and cultivation.

Throughout the Soviet period of his activities, Michurin paid particular attention to the problem of extending fruit gardening to the new industrial centres of the country, especially to the Urals and Siberia.

In his letter to Magnitogorsk workers, Michurin called upon them "... to organize on the spot the cultivation of new local varieties of fruit and berry plants," by extensively utilizing his experience and breeding methods.

"Of course," he wrote, "to originate your own Magnitogorsk varieties is a difficult task requiring a lot of time; but this does not mean it is impossible. Given the proper enthusiasm, this work will lead to triumph like the great work of creating the Magnitogorsk Iron and Steel Works, which is one of the largest in the world."

The present orchard in Magnitogorsk occupies an area of 500 hectares.

Michurin's teaching and the enthusiasm of the people mastered the severe climate of the Urals and Siberia. It

will not be long before orchards will bloom and bear fruit throughout the Soviet land.

The Communist Party and the Soviet Government have always considered the struggle against drought as one of the most important tasks of socialist agriculture.

Michurin worked hard to help the Soviet State solve this task. He proposed that along with forest tree varieties, fruit trees and berry shrubs should also be planted in the shelter belts. Michurin believed that the presence of 10-15 per cent of fruit and berry plants in the shelter belts would supply additional millions of tons of fruit and berries to the canning, confectionery and wine industries. Fruit trees would attract bees, and this would promote collective- and state-farm apiculture and immeasurably increase honey and wax yields. Moreover, since bees act as pollinators in fertilizing cross-pollinating agricultural plants, they would play a tremendous role in raising crop yields and improving the quality of the seeds of buckwheat, sunflower, mustard, chanterelle, vegetables, and of such valuable forage plants as clover and alfalfa.

Michurin raised a number of remarkable dwarf varieties of fruit plants for the shelter belts that best meet the requirements of snow retention.

In his *Request Addressed to the Sixteenth Party Congress* (1930), Michurin wrote: "The present mix-up of small intermittent patches of land cultivated by individual peasants *will give place to uninterrupted fertile fields girdled with strips of orchards. Field-orchards* will be thus created."

Michurin's idea of introducing fruit and berry plants into the shelter belts is being carried out on a big scale.

Advanced Soviet agrobiology is based on the creative combination of the teachings of I. V. Michurin and T. D. Lysenko on the transformation of the nature of

plants, with the doctrine of the outstanding Russian scientists Dokuchayev, Kostychev, and Williams dealing with soil formation and methods of raising the fertility of the soil. This science is a powerful weapon in the struggle for the florescence of socialist agriculture.

The Apsheron Peninsula juts far into the Caspian Sea, and when the north wind blows it raises clouds of dust in Baku, the beautiful capital of Azerbaijan, which is situated on the southern coast of the Peninsula. Oil prospectors and oil-industry workers stand in great need of protective vegetation—parks, orchards, vineyards, lawns, and flower beds. The planting of vegetation is to a large measure impeded by strong desiccating winds, low precipitation, and by the arid soil which is mainly sand with an admixture of salt. However, these obstacles did not stop the Soviet people.

Michurin shared actively in planting vegetation in Baku and in its oil-bearing districts. Despite all "scholarly" phrase-mongering and misgivings by doubters, he gave the delegation from the Baku City Soviet important instructions on how to overcome the unfavourable local conditions, and recommended what forest and ornamental types and varieties of fruit trees should be planted. Michurin sent to Baku an expedition consisting of his best pupils to organize the planting of vegetation on the shore drives, in the streets, squares and boulevards.

Michurin showed every concern for the progress of his work—the raising of new varieties of fruit and berry plants and the introduction of his methods into the practical plant growing activities of collective and state farms. He had great faith in the creative endeavours of the workers and collective farmers, and put firm trust in the Soviet youth. He was always ready to welcome the numerous visitors from institutes and schools to his nurseries and laboratories. Michurin wrote many newspaper articles addressed to young people and maintained a

large correspondence with members of the Komsomol and the Young Pioneer Organization.

"My young friends," he wrote in one of his letters to the youth, "we live at a time when man's loftiest mission is not only to explain the world, but to change it, to make it better, more interesting and comprehensible; to transform it so that it would fully meet the requirements of life. I have been working to improve plants for sixty years. Some say that I have done a great deal. I should, however, say that not so much has been accomplished in comparison, at least, with what can and must be done.

"Much will have to be done by the coming generations, and, particularly, by you, my young friends.

"Every agricultural plant, even the ones that appear to be the best, can and must be improved."

Appreciating the great role that the breeding of plants has for the progress and burgeoning of socialist agriculture, Michurin believed that "... instruction in plant breeding should be introduced in all agricultural schools, from primary schools to colleges."

Thousands of collective-farm schools, laboratories, agrobiological stations and Michurinist circles, scattered throughout our boundless Motherland, are mastering Michurin's materialist teaching. They correspond with the Central Genetics Laboratory and the Michurin Scientific Research Institute, where they send their representatives for practical work, and propagate the Michurin varieties.

Michurin's activities in Soviet times yielded staggering scientific and practical results. In 1932, when the great successes of socialist construction were manifest, Michurin summed up the results of his scientific activities and wrote the following:

"What vast, boundless and radiant vistas have opened up in our Soviet Union for the development of scientific ideas.... This can be seen from the fact that during the

past year (1932) alone I obtained 120 productive varieties of fruit and berry plants. Some of them are very important for our socialist industry and should take their place of honour in the world assortment of fruit growing. Consequently, during the last year alone, under the Soviet power, I obtained as many new varieties as I had cultivated in forty years under tsarist autocracy."

"At the present time," Michurin wrote in 1934, on the eve of the sixtieth anniversary of his creative work, "the assortment I have cultivated contains over three hundred varieties and represents a substantial basis for the socialist reconstruction of fruit and berry cultivation not only in the European, but also in the Asiatic part of the U.S.S.R. and in the high-altitude areas of the Caucasus (Daghestan, Armenia)."

On September 20, 1934, the country celebrated Michurin's eightieth birthday and sixtieth anniversary of his activity in plant breeding. This notable jubilee turned into a veritable festival of Soviet agrobiology.

J. V. Stalin sent Michurin warm congratulations.

The telegram read:

"Comrade Michurin, Ivan Vladimirovich,

Most sincerely congratulate you, Ivan Vladimirovich, on the occasion of the sixtieth anniversary of your productive labour for the weal of our great Motherland.

Wish you health and new success in the work of transforming fruit growing.

I warmly shake your hand.

J. Stalin"

Michurin was congratulated by the Central Committee of the Communist Party, by the Presidium of the Central Executive Committee of the U.S.S.R., and the Council of People's Commissars of the U.S.S.R. as well as by numerous representatives of State, Party, social and

scientific organizations. A special Government delegation came to Michurinsk to arrange the jubilee festivities.

Upwards of 1,000 collective farmers and workers from the Arkhangelsk, Ivanovo, Voronezh, Kursk, Leningrad, Smolensk, Gorky, and Stalingrad regions, from the Donbas, the Ukraine, Byelorussia, the Urals, and Siberia arrived to congratulate the people's scientist. Fifty thousand workers of the town of Michurinsk and collective farmers of the Michurinsk district, as well as representatives of other towns and collective farms took part in the jubilee demonstration.

On the day of the jubilee the Presidium of the All-Union Central Executive Committee conferred on Ivan Vladimirovich Michurin the high title of Honoured Scientist.

In reply to the congratulatory speeches, Michurin said at the anniversary celebration meeting:

"Comrades, first of all I wish to thank you for your congratulations.

"I should like to see every collective farmer in every collective and state farm have a fruit tree which he raised himself. Some people have already done that; for example the workers of the engine-repair plant in Michurinsk have cultivated those of my varieties of trees that bear fine fruit.

"I would like to mention also that only in Soviet times was I given the opportunity to develop this work. Before these times I had been unable to carry it out on such a scale or to interpret it in such a clear and positive manner. The Soviet Government provided me with everything I needed."

The Soviet press gave front-page prominence to Michurin's jubilee.

"The great task of renovating the land," said the *Pravda* editorial on September 23, 1934, "was started with the Proletarian Revolution, with socialist construc-

tion which opened up unlimited potentialities in all branches of science and engineering.

"For this reason Michurin could devote himself entirely to his work after October, 1917. It was by no means fortuitous that in the very first years after the Revolution the Bolsheviks were able, through the smoke and powder of the Civil War, to see Michurin's nursery neglected in a far-off provincial corner, and to provide him the funds he needed despite the devastation wreaked by the imperialist intervention."

Those days saw the publication of the third edition of Michurin's works in which he gave a fuller exposition of the great teaching on the transformation of vegetable organisms for the benefit of toiling humanity.

In the forty-two years that Michurin worked under conditions of tsarist Russia, he could not make public his ideas in a single pamphlet, while during the five-year period between 1929 and 1934, the Soviet Government published his works in three editions.

In the winter of 1934-1935, in spite of poor health. Michurin carried on working to a timetable he had kept over several decades. He drafted plans for plant breeding in 1935; continued his diary; received collective-farm gardeners, scientists, and students and talked to them about methods of cultivating new highly productive varieties of agricultural plants. As always, his assistants visited him twice a day, and his closest associates were constantly at his side. Michurin continued corresponding with his friends, plant breeders in all parts of the U.S.S.R. and worked at the carpenter's bench. He was a great reader of fiction and he often spent the little leisure reading a book.

The teaching on the collective-farm system and on socialist agricultural production elaborated with such genius by Lenin and Stalin, that was implemented with unprecedented success, had by that time already

transformed the country's agriculture, as well as the people themselves; and whenever anyone spoke of the great future of collective farming, Michurin would say with happy excitement: "The Bolsheviks always succeed in everything they undertake. There will be plenty of work for all."

On February 7, 1935, Michurin wrote the following inspiring lines in his greetings to the Second All-Union Congress of Collective-Farm Shock Workers:

"...In my opinion, every collective farmer must be an experimenter and, it goes without saying, that the experimenter is a transformer.

"Life has changed—it is full of the meaning of existence, interesting and joyful. Therefore animals and plants should be made more productive, hardier and more able to meet the requirements of this new life. But this is possible only on the basis of an all-powerful technique and omnipotent selection."

Invariably striving to promote horticulture, Michurin, in his appeal to collective farmers in the Moscow region, wrote:

"The day is gone when ownership of fruit orchards was within reach of only the landlord or the rich kulak.... The time has come for the bloom of a highly efficient and marketable fruit gardening. The collective-farm system affords the opportunity of quickly solving this task. Comrades collective farmers, you are in a position to provide, in the shortest time possible, foodstuffs of the highest value such as fruit and berries to workers in towns and, what is of particular importance, to children."

Michurin followed the growth of socialist industry with keen attention. The great might of Soviet economy already made itself felt after the successful fulfilment of the first five-year plan. Michurin eagerly read reports in newspapers and magazines about every new achieve-

ment of socialist industry which, as early as 1934, was directing to the collective farms an endless stream of tractors, automobiles, various ploughing and harvesting machinery, mineral fertilizers, and chemicals to combat pests and agricultural plant diseases.

For several days after he read a booklet published in the Urals about the Magnitogorsk Metallurgical Plant, whose construction had just then been completed, Michurin used every opportunity in between work to give his assistants and family an enthusiastic account of this huge plant, of the might of Soviet technical science and of the wide scope of Bolshevik economic enterprise.

The workers of the reconstructed Kramatorsk Machine-Building Plant invited Michurin to come to the festivities arranged on the occasion of the launching of the plant. Michurin was ill at the time and forced to stay in bed, but he asked for a copy of the *Pravda* containing a description of that new giant of Soviet machine-building. He read everything dealing with the plant and, incidentally, warmly praised the initiative displayed in planting greenery to protect the health of the workers.

The Second All-Russian Fruit-Growing Conference opened in Michurinsk in the beginning of March, 1935, and though Michurin was unable to attend, he nevertheless took an active part in its work. He gave valuable pointers to the organizers of the Conference and received delegates from the Crimea, Daghestan, Transcaucasia, Byelorussia, and Bashkiria. He advised the delegates to the conference on experimental technique and familiarized them with his methods. Michurin told them what new varieties of apple, pear, cherry, and plum trees should be tested and pointed out the wildings that could be used for their propagation in fruit nurseries, and what scientific methods should be used. Michurin's recommendations concerning the extension of citrus fruit to new regions proved to be of great value.

Komsomol delegations from the Transcaucasus (Azerbaijan, Georgia, Ajaristan, and Abkhasia) acquainted themselves thoroughly with Michurin's work and methods, and with his articles in the magazine *Sovetskiye Subtropiki* on problems of growing new sorts of lemons, oranges, and tangerines with a higher frost resistance, as well as on problems of his selection method; all this undoubtedly played a great role in developing a mass movement for experimentation in the Transcaucasus.

Newspapers in Georgia and in the former Azov-Chernomorsk territory did important work in popularizing Michurin's pointers. Komsomol members in these areas kept in close touch with Michurin. They set up Michurinist laboratories in collective farms in all the fruit-bearing districts and achieved notable successes in plant selection and pushing the citrus tree to the northernmost parts of the Caucasus and the Kuban where it never grew before.

Michurin wrote tens of thousands of letters in the sixty years that he spent over his work. He knew and loved his people and always wanted to be understood by and useful to them. In one of his diaries, for example, he noted the following:

"In every talk with excursionists as well as in every descriptive article one should avoid using, as much as possible, scientific terms which the layman would have difficulty in understanding. These terms are used mostly by some authors with the sole purpose of demonstrating their learning, but as a matter of fact, it always turns out that such persons are the last to command real knowledge."

Michurin's guiding principle was to test scientific theses by experimentation. His science was never divorced from practice.

"Ivan Vladimirovich, on what are you working?" some excursionists asked him one day.

"On what is useful for my country just now," he replied laconically.

Michurin always had the future in mind when he investigated problems that were of immediate importance for the country. He always marched ahead and drew others after him.

As far back as 1906 Michurin headed his notes, that later grew into his fundamental work *Results of My Sixty Years' Work*, with the following motto: "He who does not march ahead shall inevitably lag behind."

Initiative and bold thinking coupled with genuine knowledge of the subject were the qualities that Michurin valued most in people, and it was for this reason that he paid particular attention to choosing the right people, and testing them in work and practical experience.

Michurin severely criticized "college chatterers" who contributed nothing new either to theory or practice. As early as 1925, he wrote: "Though poor in scientific personnel, we cannot, without great detriment to science, afford to select people at random only on the basis of their university or academic diplomas. The fact is that some college men are only capable of selling matches in the streets, and yet because of their diplomas they imagine that they can substantiate a new science."

In his relations with scientific research workers, teachers, students, agronomists, zootechnicians, foresters, and other agricultural experts, Michurin, who was a materialist and dialectician, always viewed ideological training in the spirit of a materialist conception of living nature as the principal and fundamental thing.

In a message to members of the Komsomol in 1932, Michurin spoke of the necessity of a dialectical approach in mastering his plant breeding methods. "...I must warn you that in utilizing my methods one should constantly look ahead, since their sheer application might convert them into a dogma, and you, Michurinists, into

simple copyists and compilers. But this has nothing to do with Michurinist work, as my fundamental method consists in constantly looking ahead, in verifying, and in modifying my experiments, and in investigating all moving and changing matter."

Striving to direct the Soviet youth to quests for the new, Michurin wrote in that address that even in science what sometimes seems an unshakable truth proves obsolete and inadequate.

An advocate of revolutionary daring in science, Michurin was always a very exacting and strict examiner of his own scientific achievements. One of his manuscripts has a note that is characteristic in this respect. It says: "While carrying on my pupils should run ahead of me, contradict me, and even negate my work. For it is only by such consistent negation that progress is created."

Michurin, who in spirit was a people's scientist, highly valued the achievements of practical men and bitterly denounced the unreasonable, unsubstantiated postulates of armchair scientists. This is what he wrote: "...any contribution, however small, made through the labour of men engaged in this work is of equal value whether it has been made by a professor of botany or a common labourer in some orchard."

Being a scientist and a patriot who consistently and indefatigably fought to remake nature, he was in addition an untiring propagandist of this great cause. He painstakingly selected and trained his personnel, and was a patient and generous teacher.

Tsarism created an unbearable atmosphere of moral oppression around Michurin; it forcibly cut him off from the people, and his teaching was doomed to disappear without trace.

It was only the Communist Party and the Soviet power that gave Michurin every opportunity to promote

biological science. Michurin's materialist teaching is now the foundation of the whole of Soviet plant growing and livestock raising.

* * *

Michurin was a biologist of exceptional integrity. At the same time he was a very able mechanic, electrician, a highly skilled technician and fruit grower, and a fine artist. Besides, he was the author of many inventions.

The spirit of invention, always inherent in Michurin, enabled him to find a way out of the most difficult predicaments caused by lack of funds to purchase special scientific equipment.

Looking back to 1888 we find that Michurin published an article on an ingenious sprayer he had invented "for room flowers, for plants in conservatories, and hothouses as well as in hotbeds and in the open air." The sprayer was recommended to fruit growers by the editors of the magazine *Russkoye Sadovodstvo.*

When Michurin cultivated his own variety of cigarette tobacco, he could not find a portable machine to process it, and was compelled to design and construct a hand-driven cutting machine himself.

When he lacked funds to buy a distilling apparatus to determine the essential oil content in a new variety of spurge roses which he raised, Michurin designed and constructed a fine distilling device which is still used successfully by biochemists and technologists at the Michurin Central Genetics Laboratory.

Michurin designed a piston pump to water the plants in his nursery and a light internal combustion engine to run it, but before the Revolution he did not have the money to make test models.

After working out the technique of hybridizing plants, Michurin continued to develop and perfect it. His

Situation Book has a drawing of an *Instrument for Pollination*, which is a spring pincers with spoon-like ends. This instrument is handy because it automatically collects the pollen, which, when mature, is used to pollinate the flower of another experimental maternal plant.

His work on budding (grafting plants with buds) and whip grafting (grafting plants with cuttings) is of great interest. Michurin strove to have all his graftings take root and was dissatisfied with the conventional methods, particularly when the number of cuttings obtained from the plant that interested him was small. He perseveringly searched for the most effective grafting methods. With that end in view, Michurin invented a geissfuss (a specially shaped steel chisel for whip grafting) that provided for a greater area of inosculation and higher durability when grafting a cutting to a wilding as compared with the usual method of whip grafting by a knife.

The use of the geissfuss was highly successful in numerous experiments in which Michurin and his assistants subjected fruit plants to vegetative hybridization; the maximum number of cuttings struck root on plants of both close and distant kinship, such as pear on mountain ash, apple on pear, almond on plum, sour cherry on bird-cherry, etc.

Michurin's budding tool was a remarkable invention. The ingeniously designed mechanism of this small hand-operated device makes uniform cuts in both the eye (bud) of the cultured cutting and in the wilding, the eyes being put into the cuts of the wilding. Not only did the budding tool greatly increase labour productivity in the process of budding wildings, but what is far more important, it ensured the eyes with the highest capacity to strike root.

"Hardly any change," Frederick Engels said, "takes place without the accompaniment of electrical phenomena.... The more care we exercise when investigating

the most diverse natural processes, the more often do we find traces of electricity."[1]

In his work on the directed training of hybrids, Michurin regarded electricity as a great and very important factor. That is why he applied electric power in addition to various scientific methods. He constructed a hand-driven dynamo for use in his work. Michurin also purchased an electrophore machine that placed at his disposal both dynamic and static electricity; he made it react on seeds, cuttings, whole plants, and their pollen. He often electrized the soil under the plants he experimented on.

Michurin raised the vitality of fruit plants by subjecting pollen to the action of electricity. Through the electrization of the soil (galvanic electricity) he stimulated the growth of grapes, apple, pear and apricot trees, of roses and other plants.

While attaching great importance to the use of electric power, he took it into account only in conjunction with other factors of the environment—the composition of the soil, the presence of nitrogen and oxygen in the air, the temperature, light, moisture, organic or mineral fertilizers, the presence of atmospheric electricity, etc.

"In the nineties," Michurin writes, "I made use of the influence of discharges of static electricity upon pollen, but the cause of success could hardly be attributed to the action of electricity alone, which in these experiments was inseparably connected with the inevitable ozonization of the pollen.

"The pollen was also subjected to the action of weak inductive electric currents. Lastly, it was placed for a brief period in the interpolar space of powerful magnets. I shall not set forth here the results of such experiments

[1] F. Engels, *Dialectics of Nature,* Russ. ed., Gospolitizdat, Moscow 1950, p. 83.

or what deductions are to be drawn from them in view of the fact that they have not been completed.

"Such experiments, if they are to be conclusive, require all one's time—a condition which I could not meet. Here I have made brief mention of them only to point out to my followers the possibility of applying them in hybridization."

Some "historians" consider the Italian scientist Pirovanni as the innovator in the application of electricity in vegetable organisms. As a matter of fact, Pirovanni first took up this subject in 1912, while Michurin was already applying it in 1892.

Whenever he needed an instrument which was either non-existent or which he could not afford, Michurin at once went to work making it.

Before the Revolution the cost of a portable typewriter was beyond Michurin's means and so he constructed one himself.

One day Michurin broke the glass on his rectangular-shaped wrist watch. It was difficult to find a glass to fit his unusually shaped watch. However, near a bed of tulips and daffodils he found the splinter of a large bottle made of exceptionally pure glass and he used its cone to make an excellent glass for his watch.

Sevastyanov, a machinist and a friend of Michurin's, was unable to find a job because of a reputation of being "politically unreliable," although a court had found him innocent of a railway accident that took place in 1905. Long unemployment reduced this highly skilled worker to poverty.

By that time Michurin had completed the invention of a metal portable stove with a high heating capacity, and needing a small quantity of fuel.

Its low cost, the economy that it gave in fuel and its obvious advantages for heating living quarters and convenience in cooking made the stove a real godsend for workers who in those days lived in huts, basements and hovels.

To help his friend out of penury, Michurin gave him the invention gratis and they jointly published an advertisement. By making and selling these stoves, Sevastyanov was able to provide for his family. He gave up this work after his reinstatement at the engine-repair shop.

Rationalization schemes and ideas never left Michurin's mind. During the last years of his life he was very interested in the development of automatization and found great fascination in reading technical literature to which he subscribed regularly.

Michurin followed with live interest the development of inventions in the U.S.S.R. The automatic coupling of train carriages, and machines like coal-cutters and mechanical picks always evoked his admiration.

The appearance of Soviet stratospheric balloons, dirigibles, the *Maxim Gorky*, an aeroplane specially designed for propaganda flights, and particularly K. E. Tsiolkovsky's brilliant works in the field of constructing all-metal airships and rockets filled Michurin with indescribable enthusiasm and admiration for the scope of Soviet technical ideas.

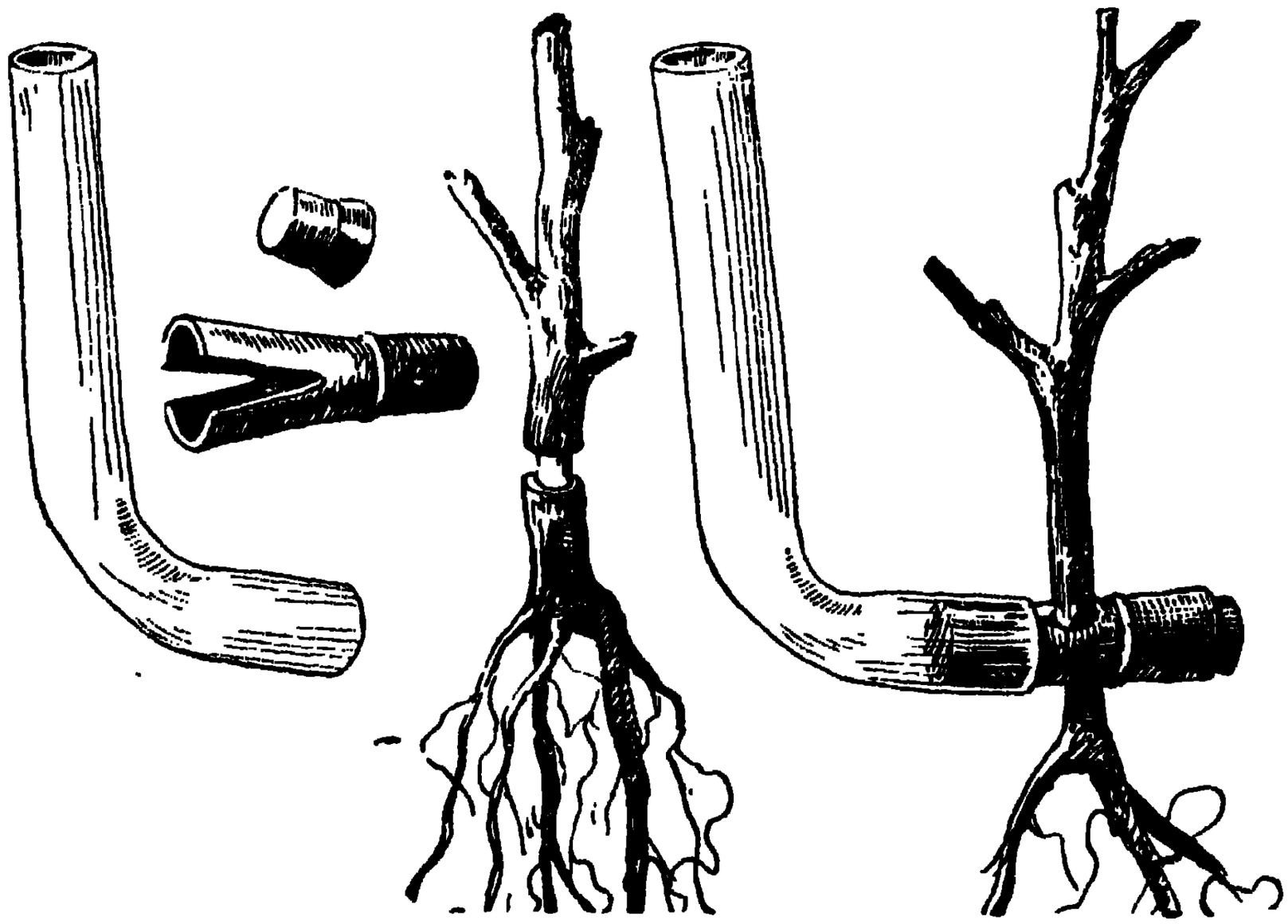
Michurin always considered the spirit of invention and high technique in every work as the foundation of progress. He wrote:

"1) There is not a single art, handicraft or science that does not have definite techniques which have been acquired by constant exercise.

"2) He who does not master the technique of some art, science or handicraft will never be able to create anything of outstanding value."

In order to propagate and improve the "properties of new hybrid varieties of pears," Michurin worked out an ingenious method of cutting the roots of this plant in the air. This method is as follows: after selecting on the tree a shoot suitable for branching, Michurin removed by incision a small strip of bark (1.5 cm. wide), and covered

the spot with a longitudinal slit rubber tube, which he very neatly tied with thick thread smeared with grafting wax. The unslit end of the rubber tube was stopped up with a cork. Both halves of the slit parts of the tube were inserted into one of the ends of a glass tube bent at right angles and this was filled with cooled boiled water. In



Tube for rooting cuttings

two months a callus appeared at the lower end of the shoot, in the gap of the rubber tube, and then roots. Michurin then cut this rooted shoot off the tree and planted it directly in the bed where it soon struck root.

In this way it is possible to obtain layers from both the branches and crowns of annual or biennial shoots. This method acquires particular importance when buds or whole shoots with sport deviations appear on separate branches of the crowns of fruit plants, i.e., shoots with a changed hereditary basis which can be altered in the desired direction through proper training.

"This method of rooting," says Michurin, "when it is fully worked out methodologically and technically, promises to cause a veritable revolution in the art of fruit growing in the future."

Long before elaborating this method, Michurin used to root cuttings of sour cherry trees by means of one of

Formation of roots in the tube and thickening of cuttings above tube

Cutting with roots formed in tube

his inventions—a box with a ribbed bottom and an exhaust pipe under it. In this connection the following curious thing happened. Having succeeded in rooting the cuttings of sour cherry trees, Michurin decided to make public his success in the press. He wrote an article and mailed it to A. K. Grell, then editor of *Russkoye Sadovodstvo*. Some time later the manuscript was returned with Grell's inscription: "Not suitable. We publish only the truth."

This angered Michurin. He dug out three cuttings with richly developed roots and sent them to Grell with-

out any covering letter. Grell's reply was a diffuse apology and a request for the return of the article.

It is a matter of great importance to notice in the hybrid some deviation in the structure of a cotyledon or leaves; in the form of a sprout, the crown, or flower, in the shape or colour of the fruit, say of a fruit plant; in the ears or panicles of cereals—rye, wheat, buck-wheat or millet. And having observed some deviation one must not disregard it but fix it at once, i.e., take a photograph or, still better, make a drawing of it.

Michurin attached great importance to these deviations, regarding them as signs of the individual development of the organism of one plant or another. He lost no time in fixing such deviations, noting down their descriptions or having them photographed or drawn. He said that nature "...in creating new forms of living organisms produces an infinite variety and never tolerates repetition."

If one remains indifferent to an important phenomenon, not only may it be missed, but a new form (variety) of a plant, highly valuable to the national economy of the country, may be lost forever.

Science investigates plants and animals in their natural state, such as they exist in reality. Botanical truthfulness is required when drawing a plant or some of its parts. As early as 1889-1911, Michurin made strikingly accurate drawings of seeds, stalks, leaves, flowers, and fruits, with which he illustrated his articles and the catalogues of his nursery.

He made especially masterly drawings of cuttings, buds, graftings with eyes or cuttings, garden tools as well as of pests in all phases of their development—eggs, caterpillars, chrysalices, and butterflies. Truthful and artistic, too, were his drawings of the apple, pear, and apricot, of the seminal ducts of plants, of seeds, etc.

Michurin's perseverance and industry is testified by

his long years of untiring work to raise frost-resisting varieties of grapes, peaches, apricots, and sweet cherries with the aim of spreading them to the Tambov, Ryazan, Tula, and Moscow gubernia.

Of course, Michurin clearly saw the difficulties of cultivating frost-resisting varieties of fruit; and he wrote in 1902:

"1. One must remember that the territory of Tambov gubernia lies beyond the boundary where the cultivation of the existing varieties of peaches is possible and that the northernmost boundary of peach raising is over 600 *versts* to the southwest, the line passing through Balta, Berdyansk[1], and Stavropol. (Proceedings of the World Congress of Fruit Growers, 1894.)

"2. Let us assume that the said boundary line is too distant, particularly if we take into account the exceptionally hardy varieties of peaches that have been recently raised.... When cultivating these, the line can be moved more than two hundred *versts* to the northeast and drawn through Warsaw, Kiev, Poltava, and Astrakhan (this boundary exactly coincides with the northern boundary of apricots). Even then it will be four hundred *versts* from Tambov gubernia. This is enough to kill all hope that peaches can be grown in our locality.

"Firstly, however, man wants what he has not; secondly, what has man's stubborn and persevering labour and patience not achieved? One must look for ways and means." What great faith these lines imply in the steadfast and patient labour of a lone researcher relying on his own meagre earnings!

In the winter of 1901-1902, when the temperature dropped to 28 or 29 degrees Centigrade below zero, frost destroyed Michurin's vast collection of peach seedlings grown from stones gathered with great difficulty in areas

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[1] Now Osipenko.—*Ed.*

northernmost for this culture—in regions of the Ukraine (Kiev), the Don river (Cossack village of Archadinskaya), and Central Asia (Alma-Ata). In the spring of 1902, when Michurin saw the dead, blackened peach seedlings, he did not waver or lose heart but thoroughly inspected the plants, the parts above the ground as well as the roots, and on returning home he wrote:

"And so, not a single specimen of the whole collection of 2,800 peaches remained intact. Yet, in my opinion, this does not finally prove the impossibility of cultivating peaches in our locality, and hence, I will continue the struggle."

His failure to raise a frost-resisting variety of peach made Michurin draw the following conclusion:

"The winter with its frosts is not to blame for this, it must not be regarded as a scourge of our horticulturists; on the contrary, our sharp frost is a just inspector, a capable, diligent and up-to-the-mark sorter in our gardens, a patient, attentive, all-sided teacher and instructor of horticulturists, and at the same time an unbiassed judge of their knowledge, skill, industry, and attention to his instructions and lessons. Yet it is this inspector and teacher that from time immemorial people are in the habit of blaming for every fault of theirs, always complaining against him because he follows a course according to programmes and plans which not they have established.... I believe that we are far from being right in our complaints against the actions of Nature. We ought not to complain against her, but patiently learn from her, endeavouring to rectify our mistakes in accordance with her laws."

"One must search for ways and means," wrote Michurin. And he did find them. Today the Central Genetics Laboratory in Michurinsk cultivates about twenty varieties of frost-resisting grapes raised by Michurin and his pupils. These varieties successfully grow and bear

Michurin Beurré Zimnaya
diminished

fruit in upwards of five hundred places in the U.S.S.R.—in the Tambov, Ryazan, Tula, Moscow, Smolensk, Ivanovo, and Pskov regions, in the Middle Volga country, and in Bashkiria. They have proved to be frost-resisting and high-yielding, and their gustatory properties are not inferior to many Don and Astrakhan grapes which are typically southern varieties.

Michurin also solved the problem of raising frost-resisting apricots, Reine Claude plums, and sweet cherries. The new frost-resisting varieties of these plants thrive well not only in the Tambov region but also near Leningrad and Moscow, and Malaya Vishera and Smolensk. Michurin did not live to see the cultivation of northern peaches, but he put into the hands of his pupils and followers a method that will make possible the solution of this problem, too.

Many of his experiments lasted decades. Success alternated with failure, yet he went on repeating his experiments until he reached his goal.

STYLE OF WORK

Michurin's style of work, his life and activities in the "green laboratory of nature," as he called his nursery, are highly instructive.

When in 1899-1900 he moved his nursery to its present site near the village of Donskoye—this was its third site—Michurin established a timetable for work and everyday life that he followed to the end of his days, and which proved most conducive to his activities.

At five in the morning Michurin was already up. After taking a look at the barometer and the outdoor thermometer, Michurin went to his verandah where he was eagerly awaited by his feathered friends—sparrows, pigeons and jackdaws, many generations of which he had

been feeding for over thirty years. Hempseed, millet, and bread crumbs serving as feed were prepared beforehand, in the evening. In winter he fed the birds in the morning and in the evening.

"One should help birds in winter," Michurin used to say, "but to feed them in summer means to deprive them of independent action and to develop parasitism in them. I know that I am not doing the right thing, but still I feed them."

Chirping and cooing, the sparrows and pigeons sat on his head and shoulders, and on his grain-filled palms. "How can one chase them away," he said. "No, that is impossible."

At six he breakfasted with two or three of his close associates. Everyone was served a glass of boiled milk, tea, a slice of bread, and some home-made patties.

At breakfast, which resembled a "planning meeting," all the tasks of the day would be determined: the work to be done in the nursery, in the laboratory or in the study workshop, the errands of the day and their purpose, etc.

From seven till noon Michurin was in the nursery busy with diverse work: planting seeds, grafting plants, selecting seedlings, and jotting down brief pomological descriptions of hybrids. He always carried a note-book to write down all his observations and remarks, as well as the subjects of his research work. He received his visitors in the orchard, sitting on a bench under a tree. In the busiest hours of plant hybridization, which as a rule were between ten in the morning and noon, Michurin could always be seen near the trees with a little portable laboratory in his hands.

The castration and isolation of flowers, the collection and preservation of pollen and, lastly, pollination must be done carefully and quickly. That was why Michurin prepared long beforehand, in winter, the tweezers, magnifying glasses, test-tubes, isolation tools, knives, chemicals, and everything else that he needed for his work.

He never tolerated late-comers, delays or negligence. Students doing practical studies, worked silently and efficiently over flowers, and Michurin, who supervised their work, was an exacting teacher and never suffered laxity or disturbance. No one dared to distract the students from their work.

The mail arrived at half past eleven. Michurin would look it through on the spot, in the summer house, and, taking with him the letters, newspapers, catalogues, and magazines, would go for his dinner.

Dinner was served at noon, and it usually took half an hour.

After dinner he read the newspapers and periodicals for one hour and a half and then took an hour's rest.

From three to five in the afternoon, depending on the weather and circumstances, Michurin worked in the nursery, hothouse or indoors.

After tea, which was served at five o'clock, Michurin worked on an article, made entries in his diary or read political or technical literature. At these hours he often received late-coming visitors from distant parts of the country.

At nine in the evening supper was served, after which silence reigned in the house. Michurin worked till midnight, answering letters, which he did by himself up to 1924, or preparing his works for publication.

When circumstances changed so that it became necessary to work at night, Michurin abruptly broke the established timetable but reverted to it when he returned to his routine work.

His precarious material condition under tsarism and the large amount of work prevented Michurin from leaving his home. He was, therefore, glad to receive people who came to see him on business, particularly serious-minded practical workers and experts. He could not stand the visits of idle, unprincipled and irresponsible officials

of the tsarist Department of Agriculture. In his autobiography, written in 1914 at the request of *Sadovod*, a magazine published in Rostov-on-Don, he declared: "I simply have no time to entertain sundry inspectors, gardening instructors, forestry experts, and others. It is all very well for them to make such trips—their loss of time is compensated on the twentieth of each month, but I have to work and every hour matters to me.... I spend the whole day in the nursery, and the better part of the night answering letters.... And how tiresome these gentlemen are with their odd messages, which is the least that can be said of them!

"Sometimes the signature to a note is such that you cannot even make out the author's name. The stamp alone tells you that this post-card, couched in very impolite terms and written in a very disorderly manner, has been sent by some head of a government office. You read it and wonder at the arrogance, and what is more, the complete groundlessness of the demands put forward in it, as for example: 'Please, send at once some samples of plants of new varieties,' or 'mail all your works on hybridization, as I need them for reference....'"

The scope of Michurin's work was tremendous. "I made tens of thousands of experiments," he said in his autobiography. "I grew a vast amount of new varieties of fruit-bearing plants from which several hundred new strains suitable for cultivation in our orchards were obtained, many being in no way inferior in quality to the best foreign varieties."

'A human life," Michurin said, "does not suffice to watch the results of the activity of three generations of an apple tree." His immense capacity for work, iron discipline, keen sense of observation, ability to use effectively every moment of his time and to take quick decisions on every question that arose, enabled him, however, to

watch over, not three but many generations of perennial fruit plants.

Michurin's study served both as his office and laboratory; it was his library and mechanical shop as well. It was here that the instruments and tools invented by him were made, machined and polished. Visitors, too, were received by Michurin in this room.

His study was unique. It had shelves filled with books, manuscripts, blueprints, drawings, and letters; a number of bookcases stood in it and behind the glass of one of these bookcases there were phials, test-tubes, and jars. Another bookcase contained moulds of plants and berries. Various apparatus and electric instruments filled all the available space.

In one corner, between the carpenter's bench and a bookcase, stood a small oak cabinet with a set of various fitter's and joiner's tools. In the other corners, between the bookcases, there were gardening tools—spades, pitchforks, hoes, sprayers, pruning knives, and saws.

Michurin's chair stood between a bookcase, a table, and a bench. The bookcase, convenient for keeping both books and moulds, was so placed that Michurin could get the book he needed without standing up. The opposite end of the bench was fixed like a bookshelf and here Michurin kept his reference books, newspapers, and magazines. A microscope and magnifying glasses of various power lay on the table, and a vice, a small anvil, hammers of various sizes, files and drills were placed on one side of the bench together with an electrophore machine and a typewriter. A little higher, on a bookstand, there were diaries and note-books, and on the walls, geographical maps, barometers, thermometers, chronometers, and various hydrometers. Next to these was a wireless set and a telephone, and at the window—a lathe.

The opposite corner was occupied by a hand-carved cabinet, containing seeds received from every part of the world. This cabinet was presented to Michurin by M. I. Kalinin after the latter's second visit to the nursery. An inscription on it reads: "TO I. V. MICHURIN, THE GREAT MASTER OF NEW SPECIES OF PLANTS, 1933. M. KALININ."

Michurin was very proud of this gift.

Whenever he read a newspaper, a magazine, a scientific treatise or fiction, Michurin always underlined the passages that interested him and made notes on the margins. If the underlined passage dealt with a scientific discovery, an ingenious scientific method or dealt with an unknown plant, he at once made note of it on the inner side of the cover and unfailingly marked the page that drew his attention. In this way the inner sides of the covers and title-pages of the books of his personal library furnished an additional reference source. The addresses of people who interested him were immediately put down in his note-book. If Michurin disagreed with an author's theses or deductions, he at once wrote down his objections on the margins of the book, or remarks that were profound and biting and sometimes finely ironic. When he agreed with an author's conclusions, he accordingly wrote his approval on the margins. Michurin expressed his views on an author's judgment in separate notes that he attached to the title-pages of the books.

His note-books, diaries and the books that interested him were filled with newspaper and magazine clippings, insertions and insets as well as with his own remarks on the material he had read.

As a rule, the notes and observations contained in his diaries and note-books bore the stamp of thorough thinking. This followed from Michurin's habit of never taking up the pen without verifying his assumptions on scores of irrefutable facts.

When a spell of failure in research work set in, Michurin tore away from his favourite world of plants and busied himself with mechanical work, repairing watches, cameras, perfecting barometers, improving garden tools and putting in a lot of work on electric instruments. He held that such a change of occupation was necessary "to refresh one's thinking capacity." After such a break he would start about his principal activities with renewed strength and energy.

Michurin approached every kind of work conscientiously and thoughtfully. For example, surgical operations on plants were carried out by him in a thorough way. His hands would be scrupulously washed, the knives sharp, and the material for tying up the plants and the grafting wax would be of superior quality. The whetting and setting of the knives and the mixing of the grafting wax were done by the most experienced and skilful assistant.

The propagation of the most valuable varieties of fruit plants by budding is a highly important and responsible operation. A proper stock must be selected, and the cuttings must be taken from the healthiest and highest-yielding trees, and the buds chosen from the cutting should be the best developed. Michurin paid particular attention to this work, and on the basis of his vast experience elaborated rules of his own. Here are some of them:

1. The cuttings of cultured varieties of apple, pear, sour cherry, plum, apricot, and sweet cherry trees, from which the eyes (buds) for budding wildings are to be taken, should be cut in the morning, when they are juiciest.

2. Cuttings should be snipped into parts of not more than five buds each. They must be kept in small narrow boxes in moist grass so as not to dry in the hands, as they wither within the first ten minutes when left on the sun-heated ground.

3. Wildings are juiciest early in the day. The grafting operations should, therefore, be carried out mainly before noon.

4. Buds take root by far better if grafted to the eastern and southern sides of the wildings.

5. Cuttings must be mature and the buds should be taken from the middle part of the cutting.

6. Buds grafted after July 10 and before August 15 (in a damp summer) take root much better than before July 10 (periods of grafting given by the Julian calendar—*A.B.*).

7. Buds take root better if grafted near or below the surface of moist soil.

8. Buds grafted in the shade wither and perish.

9. Never put the knife in the sun as the heated blade dries the cut.

What others considered a "trifle" not worth attention in an important operation was no trifle to Michurin. He always held that in one's work "trifles" are often decisive.

Two and a half months before his death, Michurin tried out some garden tools sent to him from Georgia, and was displeased because the knives for budding had black handles.

"A black handle on the black ground—is no good at all. You put it on the ground when budding, and you won't find it, or you'll lose it altogether. Knife handles should be white so as to catch the eye at once."

Michurin regarded the perfecting of technical skill in any profession as a decisive factor in the life of every worker. He used to say: "It is only by exercise over a more or less long period that one can attain technical dexterity in any kind of work."

Michurin was particularly uncompromising in the work of directing the training of hybrid plants. The law of life in the nursery, that no one dared to infringe upon, was to collect hybrid seeds and to get them ready for

I. V. Michurin in 1931

Monument to Michurin, Michurinsk

planting in a soil of a definite composition; to fertilize the soil, to remove the weeds, to water the soil and destroy the pests; to supply a mentor, to eliminate an undesirable deviation in the hybrid and to do all this in time and according to a rigid system that had been elaborated over decades.

A FIGHTER FOR THE FLORESCENCE OF SOVIET GARDENING

Ivan Michurin is dear to Soviet people because his ideological and scientific make-up combined the noble features of a people's scientist and a patriot of his country.

For more than forty years before the Great October Socialist Revolution Michurin patiently, persistently and enthusiastically put into practice his idea of improving the strains of agricultural plants, of extending fruit growing to new areas, and transferring southern varieties of fruit plants to the north. Not only did Michurin realize his idea by hard work, but he accomplished something greater than that. He originated a new science which has immeasurably enhanced man's power over nature. Michurin performed a great labour and scientific feat for the benefit and glory of his country.

Michurin wrathfully denounced the tsarist government and the "bureaucratic professors" who underestimated and impeded the advance of new scientific discoveries and inventions of Russian scholars and practical workers. Michurin was particularly indignant at the indiscriminate importation into our country of various costly varieties of agricultural plants unsuitable to our climatic conditions, and at the unhindered exportation from the country of the best home-grown varieties which were sold very cheaply abroad and led to a loss of priority by Russian plant breeders.

The officials of the tsarist Department of Agriculture deliberately hindered the promotion of the Michurin varieties, justifying this by a "... fear of cankering the orchards with low-quality strains." As far back as 1908, Michurin wrote: "A vain fear, gentlemen! The danger is not so great, and at any rate, there is less harm in this than in the introduction into our orchards of a number of varieties of foreign origin, that you like so much; they are absolutely unsuitable for the climatic conditions of our localities and most of them should have been thrown out of our orchards long ago...."

In a letter to A. D. Voyeykov on December 31, 1913, Michurin bitterly criticized the officials of the tsarist Department of Agriculture and the official scientists who ignored Russian men of science. Incidentally, the letter disclosed the tragedy of Michurin's material and moral position.

"We have been accustomed," Michurin wrote, "to treating too lightly the original works of our own Russian scholars and to passing judgment only on the basis of a most superficial acquaintance with them. No account whatever is taken of either the difficult climatic conditions or the hopelessness to which almost all Russian men of science are doomed. One cannot help noticing the disdainful appraisal of their work and the malicious, if not worse, mistake contained in one pamphlet, which says: 'Russian scientists have accomplished little because they have taken the wrong path and had not followed the rules of science.' As a matter of fact, this is far from true. If I, for example, have accomplished little, as it seems to them, during the forty years I gave to my work, the reason is a sheer and patent lack of funds to organize the work on a much larger scale, and not because it was conducted wrongly. One should not expect, and still less demand, great results, gentlemen, from such a complex enterprise which exists on meagre means

procured by the special sale of plants from a small nursery."

"Russian scientists have accomplished little because they have taken the wrong path and have not followed the rules of science!" Academic cretins and reactionary bourgeois cosmopolitans were incapable of comprehending in the least what a giant of Russian biological science, in the person of Ivan Vladimirovich Michurin, was growing and struggling in the snare of material and moral oppression. It was against these academic cretins who fawned upon and cringed to foreign "scientific authorities" that Michurin wrote in 1906 the following bitingly ironic lines: "One must honestly admit that all our knowledge amounts to the ABC of horticulture—to plant in this way, to graft in that way, so many layers and twigs in the crown; God in the shape of foreigners will send us varieties; and it is not our business to know how to raise them ourselves...."

With all his intrinsic national pride and scientific dignity Michurin fought for the creation of home horticulture. He came out against those gardeners who owned in the years of tsarism a great number of fruit nurseries and imported various foreign strains of apple, pear, plum trees and grapes that inevitably perished because they were unaccustomed to the Russian climate. At the same time these gardeners did not believe in Michurin's achievements and refused to spread his new varieties.

Describing the new economically valuable varieties of fruit and berry plants he had produced, and reproaching those Russian scientists who ignored the achievements of Russian ideas in plant breeding, Michurin ended his article, *New Achievements in the Field of Hybridization*, published in 1914 in the magazine *Progressivnoye Sadovodstvo i Ogorodnichestvo* No. 52, with a fiery patriotic appeal: "Perhaps by this last effort I shall finally succeed in drawing the attention of Russian garden-

ers and their teachers to an appreciation of both the work of originating our own Russian varieties of fruit plants to improve their assortment and to my own long years of work in this field. It is high time the Russian people awoke and became active. It is disgraceful to think that everything of the best can be obtained only from abroad."

Michurin untiringly fought for a materialist, progressive trend in biology, for the improvement of Russian horticulture.

At the very dawn of the present century there appeared the reactionary, idealistic theory of heredity, known as the theory of Weismannism-Mendelism. It was soon taken up by reactionary scientists throughout the world. There were, however, men in Russia who openly came out against this doctrine, which was hostile to materialist theory. Those who did so included such eminent Russian scientists as K. A. Timiryazev, I. V. Michurin, and M. V. Rytov.

Proceeding from the irrevocable materialist laws of the development of organic life, and considering the notorious Mendel "pea law" (established on the basis of experimentation on peas) to be absolutely fallacious, Michurin wrote in 1915 in his article *Seeds, Their Life and Preservation Until Planting*:

"Of late, our neophytes in the field of hybridization have tried particularly importunately to foist that pea law—the creation of the Austrian monk—upon us, and what hurts most is that they do not cease their efforts even though this law has been utterly condemned by our Professor M. V. Rytov, who is deserving of respect and whose personal experience certainly makes him highly competent in the realm of hybridization. In *Progressivnoye Sadovodstvo i Ogorodnichestvo*, issue No. 2 for 1914, he called Mendelism outright 'a sorry and miserable creation.' Is this not enough for you, gentlemen?

Will you nevertheless keep on bothering with this pea law and ignore the words of such a Russian authority as Mr. Rytov?"

Michurin persistently fought the Weismannist-Mendelists who denied the powerful role of environment in the formation of plants, as well as the hereditability of the characters acquired by them; they did not recognize interaction between the stock and the scion, and denied the possibility of obtaining vegetative hybrids without being able to furnish any proof.

By means of the methods of preliminary vegetative approximation he had worked out, and by using an intermediary, as well as mixed pollen and mentors, Michurin invariably obtained economically valuable intraspecific hybrids. By this Michurin irrefutably proved that not only the properties and characters of the parental forms and of their next-of-kin are inherited but also those alterations that have been acquired by them as a result of the influence of the conditions of life.

Defying the Russian Weismannist-Mendelists who, citing foreign "authorites," denied one of the fundamental principles of biological science that the stock interacts with the scion, Michurin wrote in 1916 in his article *Influence of the Scion on the Structure of the Root System of the Stock*:

"It is, in general, high time our learned horticulturists realized that they ought to refrain from making inappropriate statements in their articles to the effect that Russian horticulturists are wrong in doing this or that—statements they make in order to underscore their learnedness. You must admit that, in order to have the right to make such reproaches, one must oneself know enough about the matter and have personally accomplished something. Yet we see individuals who have not produced a single new plant (and, even if they did produce one, it was by sheer accident), undertaking to pass judgment

on those who have produced several hundred new varieties. They even make bold to argue about what they imagine is the wrong way of doing the job, always in such cases holding up as an example various famous western botanists who are, in fact, as ignorant as they themselves in the matter of breeding new kinds of plants. The fact that these persons were outstanding classifiers in botany is no reason to think that they are just as outstanding in all branches of horticulture."

In 1912-1913, some bourgeois idealist horticulturists, in their enthusiasm over *Fundamentals of Breeding Garden Plants*, a pamphlet written by Löbner, the German floriculturist, hastened to publish it as a supplement to the Russian magazine *Sad i Ogorod*.

Löbner denied, without being able to prove, the possibility of the stock influencing the scion and the possibility of obtaining vegetative hybrids, i.e., the most fundamental principles of Michurin's theory.

In *Use of Mentors in Training Hybrid Seedlings* (written in 1916), Michurin stated that Löbner had compiled the pamphlet "... not on the basis of his own observations, but of material collected here and there about the work done in this field by other people. As for himself, if he did make a few experiments, it was solely with annual flower plants. Hence his frequent erroneous conclusions and the considerable omissions in his chapters on fruit plants. In general, such compilers of data, some of whom are in effect pretty ignorant of the subject, for the most part muddle the exposition, present certain particulars of the work in a false light and crown the whole with incongruous fancies of their own, founded on nothing but analogy. And despite all the contrary opinions of foreign researchers who do not recognize the influence of the stock, I emphatically declare, on the basis of my many years' work, that this influence does exist and that, in

breeding new fruit varieties, the horticulturist must take serious note of it."

In his *Influence of the Scion on the Structure of the Root System of the Stock*, Michurin said: "... all the western producers of new varieties... who advise that new varieties should be grafted before they have borne fruit, and on wildings or on branches of adult trees, make a gross error. For what they obtain by such means is not pure hybrids resulting from a cross, but vegetative hybrids between the scion and the stock."

In criticizing scientists such as the Frenchman Tourasse, the Belgian Van Mons, the Englishman Thomas Knight, and the Dutchman De Vries before whom all reactionary idealist biologists unbared their heads, Michurin wrote: "... in the writings they have left behind there is not a single consistent and complete description of the production of any variety, and even if you do find there some fragmentary remarks on the subject, you may be sure that their authors, were they alive today, would feel ashamed of the mistakes contained in those remarks."

For over thirty years Michurin fought Mendelism that was advocated by reactionary idealist geneticists and later by the German fascists, who utilized it in their maniacal racial theories.

The Michurinist general biological teaching, that theoretical foundation of the whole of the Soviet plant breeding and animal husbandry, has turned into a colossal material force. Guided by Michurin's theory, Soviet plant and animal breeders have produced in the last fifteen years scores of new high-yielding varieties of agricultural plants and more than twenty new highly productive breeds of domestic animals. The feeble and fallacious theory of Weismannism-Morganism could not and cannot, however, contribute anything to practical work. It is for this reason that the Michurinist teaching

has always provoked, and particularly now is provoking frantic spite among reactionary scientists abroad. They hate Michurin because he has destroyed the "indestructible" canons of reactionary idealist science that plant species and animal breeds are unchangeable, because he has banished mysticism from natural science, and has irrefutably proved the absolute barrenness of the Weismann (Mendelist-Morganist) theory.

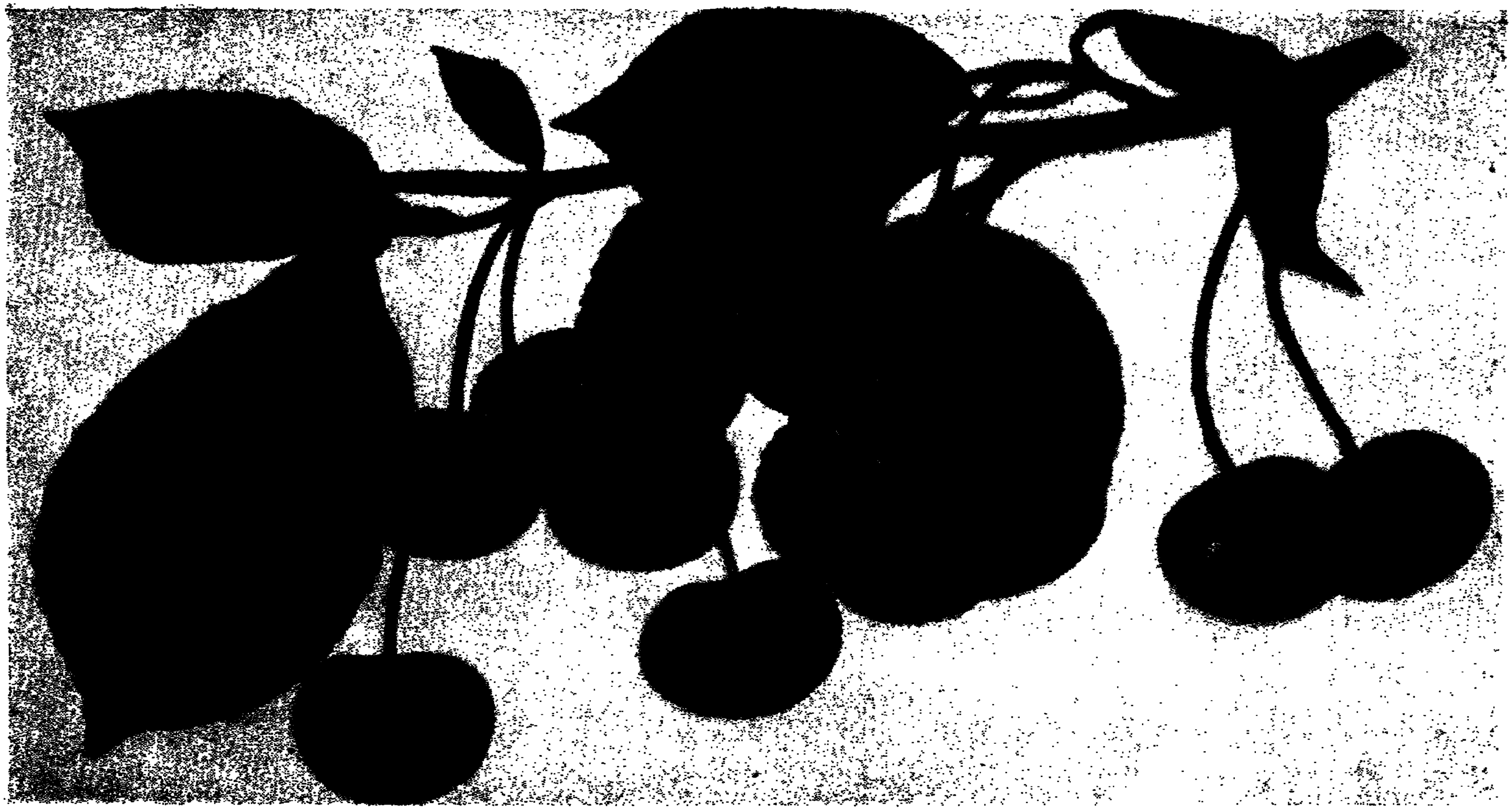
No wonder that Darlington, an English reactionary professor tried, in the magazine *Discovery* (February 1947) to discredit Soviet biology. Resorting to outrageous lying, he assured his readers that Michurin was no scientist, and alleged that he was an ordinary propagator introducing various varieties from Canada and the U.S.A.

In reality it was Canada and the U S.A. that imported from Russia the Michurin varieties of fruit and berry plants. Owing to the gullibility and at the connivance of its officials, the tsarist Department of Agriculture handed over the Michurin varieties of fruits and berries gratis to those countries, to the detriment of the country's national interests.

"In 1898," Michurin wrote, "the all-Canadian congress of farmers, which was held after a severe winter, placed on record that all the old varieties of sour cherries, of European as well as of American origin, perished in Canada, except the Michurin Plodorodnaya which came from the town of Kozlov (now Michurinsk) in Russia."

In 1911-1912, the tsarist Department of Agriculture gave Frank Mayer, an American botanist, full freedom to export from Russia to the U.S.A. a collection of Michurin varieties that are now raised there under American names.

Michurin knew well the practices of the Anglo-American capitalists who laid their hands on the best that had



Krasa Severa cherry
diminished

been originated by scientific and popular plant and animal breeding in Russia, China, India, and other countries, and then claimed it as their own.

It is well known that Arnautka and Kubanka, the world's best varieties of hard wheat, which are the fruit of Russian selection, have been sown for a long time now on millions of acres in the U.S.A. and Canada. Still more widespread in those countries is Krymka, our southern winter wheat; in 1936 it grew on half of all the farm land under winter wheat in the U.S.A.

In a letter of December 2, 1913, David Fairchild, Head of the Propagation Division of the U.S. Department of Agriculture, invited Michurin to join *Breeders*, an American plant breeders' society. He wrote: "... I also want you to become a member, because I feel that you can help us in the work we are doing here to create new and improved varieties of plants and animals.... The art of breeding is not limited by any geographical or political barriers and the American Breeders Magazine wants to give a survey of the most interesting and picturesque phases of its progress all over the world...."

In reality it turned out, however, that political and geographical barriers were non-existent only when the Americans appropriated new strains of plants and every discovery and achievement of Russian scientific thought. For ten years in succession Michurin was unable to get from the U.S.A. the fruits of sweet chestnut (Castanea dentata) that grow in South Dakota. He invariably received rotten fruit. Neither was Michurin able to obtain seedlings of the Golden Delicious, an apple tree cultivated in West Virginia, that interested him.

Quite natural, therefore, was his joy and patriotic pride when in 1929 in an article, *The History of the Establishment of the Nursery*, he wrote:

"At present the nursery does not require any material from abroad; it has all the cultivated and wild species

and varieties of plants it needs. This I consider to be one of the nursery's outstanding achievements, for now it has its own Reinettes, Calvilles, winter pears, sweet cherries, apricots, Reine Claudes, sweet chestnuts, walnuts, black gooseberries, Caucasian pshat, large-sized raspberries, blackberries, the best varieties of currants, early-ripening melons, attar roses, frost-resistant, early-ripening varieties of grapes, yellow cigarette tobacco, and many other new species of plants useful in agriculture."

An ardent patriot, and a fighter for the promotion of Soviet science, Michurin always considered his work to be inseparably bound with the interests of the Soviet State and the Soviet people. In 1926, when a representative of the People's Commissariat of Agriculture, before leaving on a business trip to the U.S.A., asked Michurin to write an article on his latest achievements for American newspapers, Michurin bluntly replied: "I will not write until America recognizes us, until she establishes real close ties with us."

An instance of his patriotism is cited in an article entitled "Michurin, the Russian Burbank" published in the March 1935 issue of the *Gardeners' Chronicle of America.* In that article we read the following:

"In 1912, an American came to him with the proposal that he come to the United States,—that the business man offered him a salary of $8,000 a year, a laboratory, and all the necessary equipment to enable him to continue his experiments. He declined the offer.... Michurin exclaimed: 'Think of it! They wanted me for business reasons. They couldn't understand the essence of my experiments.'"

In emphasizing the greatness of the Soviet State and social system, and admiring the enthusiasm of the Soviet people in the work of building communism, Michurin said in 1933:

"The time has come, at last, when we must not only overtake and surpass the capitalist countries in the next few years, but create a communist society in which the greatest scientific problems connected with practice may be solved quickly by joint collective effort."

THE LAST DAYS

Late in February 1935, Michurin suddenly fell ill. He lost all appetite, and his strength failed, but he did not give up his work; he took an interest in everything that went on in the nursery and in the country.

Concerned over Michurin's health, his assistants sent alarming letters, telegrams and inquiries to every corner of the country. Every day aeroplanes and automobiles brought physicians and medicines.

Michurin silently bore the harrowing pain and continued to work in bed. He read, leaning on his elbows, wrote or received his assistants.

On the night of May 11 he was delirious, but in the morning demanded a detailed report on the work of installing a windmill to water hybrid seedlings. The spring was dry and windy, and systematic, generous watering was required.

On June 5, when he regained consciousness after a relapse, Michurin asked A. S. Tikhonova to write down the place of origin of a plant that interested him:

"Write it down, Sasha, it's Komsomolsk-on-Amur. . . ."

While his mind still worked, and till the last minute of his life, Michurin lived in the world of wonderful plants he had created. He spent the last few hours, while life still glimmered in him, dreaming of the marvellous orchard where the happy men and women of communist society would live.

On June 7, at nine thirty in the morning, Michurin's heart failed and he passed away.

The Council of People's Commissars of the Soviet Union and the Central Committee of the Communist Party with deep regret informed the Soviet people of the death of Ivan Michurin, "the outstanding Soviet scientist, the bold transformer of nature, who produced hundreds of new fine varieties of fruit trees, and who devoted all his life to the service of the working people."

The whole Soviet country rendered the last honours to Ivan Michurin.

2. ESSENTIAL FEATURES OF THE GENERAL BIOLOGICAL TEACHING OF I. V. MICHURIN

MICHURIN'S VIEWS ON EVOLUTION

Michurin's general biological theory is based on dialectical materialism, the world outlook of the Marxist-Leninist Party. Materialist dialectics teaches that views and beliefs, and the whole outlook of man are determined by the conditions of material life of society.

"The order of ideas," wrote Michurin, "depends on the order of things."

Michurin's democratic way of thinking and his materialist view on development in nature began to take shape while he was still a youth. It goes without saying that young Michurin's materialism was as yet discordant, intuitive and spontaneous, but even at that early stage his progressive thoughts and advanced ideas, impelled by a materialist attitude, were manifest in everything.

Michurin's materialist world outlook further took shape and developed under the influence of the advanced ideas of the revolutionary democrats—V. G. Belinsky, N. G. Chernyshevsky, N. A. Dobrolyubov—the Russian revolutionary working class, and the Communist Party.

Michurin possessed an exceptionally keen sense of observation and a brilliant capacity for generalizing the phenomena of living nature.

He made a profound study of Darwin's principal works and of many works of outstanding Russian Darwinists such as K. A. Timiryazev, M. V. Rytov, and others.

Michurin's work was greatly influenced by K. A. Timiryazev, whose famous *The Life of Plants* was Michurin's reference book. Speaking about this book, a Darwinist critic said that it "towered head and shoulders above all its opposite numbers."

During the eighteen years of his activities in the Soviet period, Michurin worked hard studying the works of Marx and Engels. He admired the genius and wisdom of Lenin and Stalin, the great leaders of toiling humanity, in the building of the world's first Soviet socialist state, and read their immortal works with immense interest.

"Human reason has discovered many amazing things in nature and will discover still more, and will thereby increase its power over nature. . . ." It was these words of Lenin that Michurin inscribed in 1934 over the entrance to his nursery.

Proceeding from the dialectical materialist conception of evolution, Michurin taught that all living matter originated from non-living matter. Academician T. D. Lysenko says that every living body builds itself out of non-living material, in other words, out of food, out of the environmental conditions. Everything changes, perfects itself and acquires new forms most suitable for the conditions of life.

Viewing vegetable and animal organisms from the standpoint of materialist dialectics, i.e., in the eternal process of origin, change, and development, in the process of formation of new species of plants and new breeds of animals, Michurin cited in the preface to his *Results of My Sixty Years' Work* Engels' postulate of genius from *Ludwig Feuerbach and the End of Classical German Philosophy.*

"For dialectics," Michurin quoted from Engels,

"nothing is final, absolute, sacred. It reveals the transitory character of everything and in everything; nothing can endure before it except the uninterrupted process of becoming and of passing away, of endless ascendancy from the lower to the higher."

This thesis f Engels stands out in all of Michurin's numerous experiments and scientific works. The first line of his treatise *Experiments on Improving the Assortment of Fruit Plants*, written in 1927, was worded as follows: "In nature everything moves ahead unceasingly along the path of evolution, everything constantly changes. What existed yesterday cannot repeat itself exactly today or tomorrow.

"This immutable law manifests itself in all the kingdoms of nature to an equal degree."

Michurin explains the great diversity of present-day plants and animals by the process of historical development over many tens of millions of years, beginning with the simplest organisms that first appeared from inorganic matter.

Michurin could not, however, remain in passive contemplation of the multiform phenomena of living nature. Having critically reviewed Darwin's theory of evolution, who, along with materialist principles, introduced into his doctrine reactionary Malthusian ideas, Michurin continuously searched for and asserted the transformatory role that man plays in the development of nature. He enthusiastically welcomed even the smallest achievement of human thought that contributed towards enhancing man's power over nature.

Before Michurin biology was mainly a contemplative science that described and explained the development of organic life. Michurin, the people's scientist, had innumerable ties with collective and state farms, experimental stations, individual collective-farm experimenters, secondary-school pupils, college students, and young naturalists.

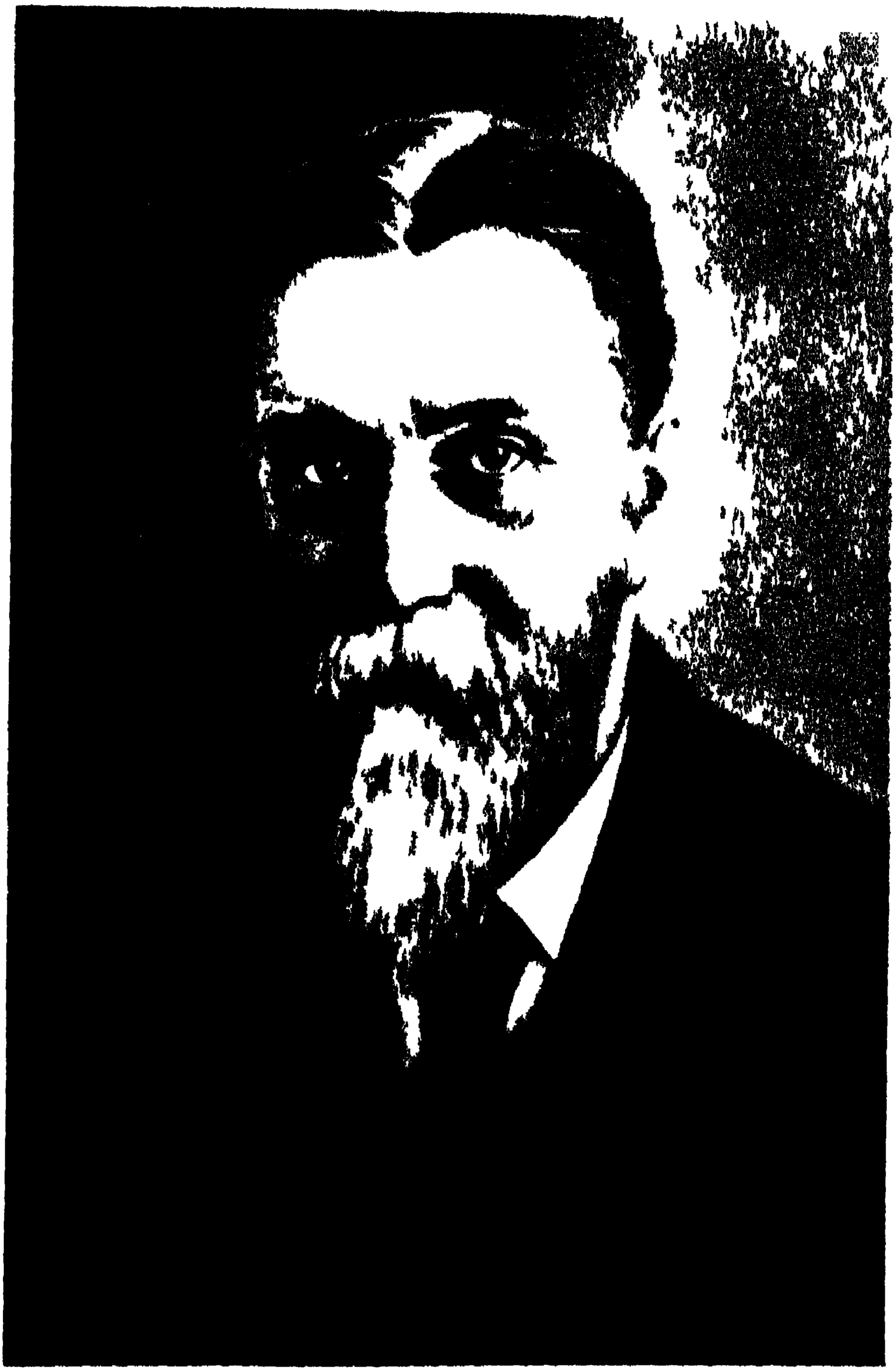
He rose in anger against "armchair botanists," "copyists" and "compilers" who had more to do with books than with living nature. From the very first days of the Soviet power, Michurin put the work of his nursery at the service of practical experience.

Basing his activities on Marxist-Leninist methodology, Michurin directed the minds of biologist-plant breeders, agronomist-plant growers, zootechnicians, and of every advanced worker of socialist agriculture towards conscious and planned alteration of the nature of plant and animal organisms, towards producing new high-yielding and high-quality agricultural plants, and new highly productive breeds of domestic animals.

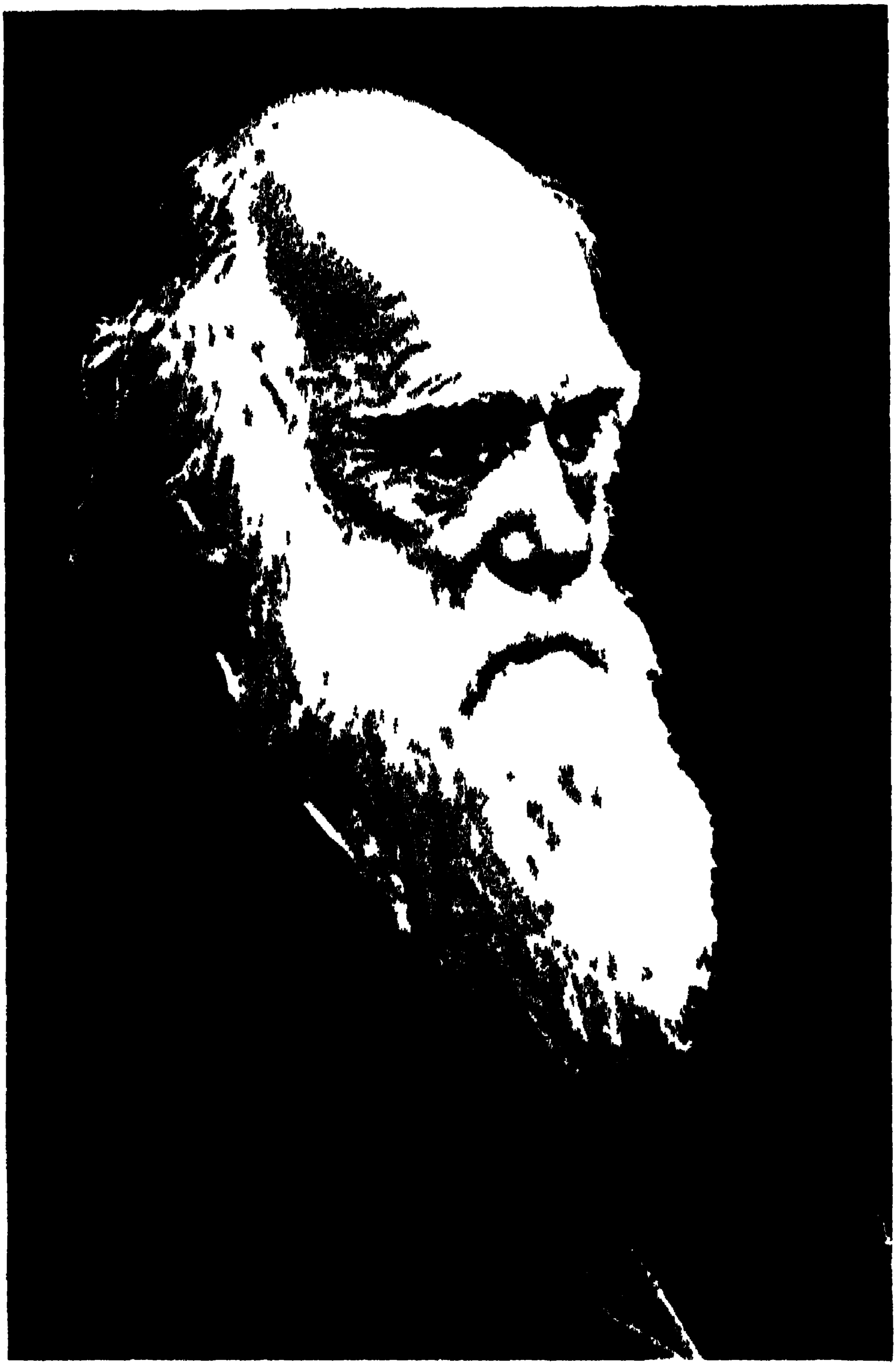
Animals and vegetable organisms change very slowly, over many centuries and thousands of years. In observing this change, man, from time immemorial, selected the best plants for seeds and the best, most productive animals for breeding, in accordance with his economic interests and requirements.

It was only in this way, by means of artificial selection of plants and animals best adapted to the conditions of life that man, in conformity with his economic requirements, gradually originated all the modern cultured varieties of agricultural plants and productive breeds of domestic animals.

This method of selecting the best and most perfect plants and animals was, however, very slow, deficient and did not correspond to the growing needs of human life. Therefore, it naturally occurred to man to hasten the process of variability in heredity, i.e., to accelerate the onset of the desired properties and characters in plant and animal organisms. There arose the striving to interfere in the process of change, to acquire the necessary power over this process so as to induce the organisms, according to Michurin's teaching, to form new, more desirable properties and characters.



K. A. Timiryazev



Charles Darwin

Prompted by the noble idea of improving the varieties of fruit and berry plants, and having discovered a dialectical materialist explanation of the laws of development, Michurin solved the principal problem of biological science, *the problem of controlling variability, of regulating the evolutionary process, thus making Darwinism a creative science.*

Rebelling against the Mendelist-Morganists, who do not recognize evolution, Michurin said: "We live in a period when nature incessantly produces new forms of living organisms, but we do not notice it because of our short-sightedness."

At the time when the Weismannist professors held sway at the Timiryazev Agricultural Institute (now the Moscow Timiryazev Agricultural Academy), Michurin supported a group of his followers from among the students who fought these reactionary and idealistic trends. In his *Wishes* to *Timiryazevka*[1] and the "Timiryazevists" sent on September 29, 1933, Michurin wrote: "I attach great propaganda and organizational importance to *Timiryazevka*, which bears the unforgettable name of K. A. Timiryazev, in the task of successfully training experts in socialist agriculture, and therefore wish to express my sincere joy that there are serious and staunch students, my followers, within the walls of the Timiryazev Institute."

He called upon the students of the Timiryazev Institute to transform the nature of plants in a direction desirable to toiling humanity. Michurin wrote in the *Wishes*: "The vegetable kingdom is not something primordial or unchangeable, as metaphysicians of all times taught and as conservatives, representing caste science, are still trying to prove. Species have changed on the

[1] A newspaper published by the students of the Timiryazev Agricultural Academy.

principle which says 'everything flows, everything changes.' And since we are destined to change the world, and not only to explain it, we must first of all change the properties of plants to suit the working people."

Michurin repeatedly expounded this superb thesis, which is infused with a Bolshevik spirit, in his addresses to scientists and practical workers engaged in selecting agricultural plants.

On October 25, 1925, his seventieth birthday and fiftieth anniversary of his scientific work, Michurin, in summing up the results of his creative activities for the benefit of our great Motherland said in his article *To Russian Fruit Growers*: "...man's interference renders it possible to *induce* every form of animal or plant *to change quicker, and moreover, in a direction desirable to man*..."

THE TEACHING ON UNITY BETWEEN THE ORGANISM AND ITS ENVIRONMENT

In order to induce the desirable changes in animal and vegetable organisms, it is necessary, first of all, to find the causes that bring about these changes. The question arises: Where do the causes of variability lie? The Weismannists (Mendelist-Morganists), who are chained to the theory of "immortal" and "unchangeable" heredity, deny the creative role of environment in the formation of organisms, are unable to solve this basic problem of biology, and relate the phenomena of variability to the realm of the unknowable and mysterious.

A direct answer to the question of the causes of the variability of organisms was furnished by Engels. "Life," he said, "is the mode of existence of protein bodies, the essential element of which consists in *continual, meta-*

bolic interchange with the natural environment outside them...."[1]

It follows from Darwin's fundamental work *The Origin of Species* that should the conditions of life alter, all the organic forms would, under the influence of these new conditions, undergo considerable changes in a few generations.

In a letter to Huxley, Darwin states bluntly: "If... external conditions produce little direct effect, what the devil determines each particular variation?"[2]

Darwin considered the assertion "... every change is connected with sexual reproduction" as clearly erroneous. He proved this by numerous facts of the deviation of plants by leaps, through the appearance of so-called sport deviations in the shape of one bud on the plant with new features (with altered heredity) which make it completely different from all the other buds on the given plant, —features which are already inheritable.

A vivid illustration of such a deviation demonstrating the character of evolution in nature by leaps is presented by the Michurin variety of the 600-gram Antonovka apple. This variety originated from the appearance of a stout double sprout (in the shape of two small branches grown together) with altered heredity on a five-year-old Antonovka Mogilevskaya Byelaya.

After grafting the buds from this double sprout to ordinary apple wildings, Michurin produced a new variety of apple tree with large fruit, weighing up to 600 grams, which is quite different from the Antonovka Mogilevskaya Byelaya variety.

Although Darwin pointed out the variability of

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[1] F. Engels, *Dialectics of Nature*, Russ. ed., Gospolitizdat, Moscow 1950, p. 244.

[2] *The Life and Letters of Charles Darwin*, Vol. II, Third Edition, London 1887, p. 233.

heredity in vegetable organisms, he hardly dealt with the causes bringing about this variability.

It devolved upon Michurin to solve the problem of controlling the variability of heredity. As a result of many years' work in sexual (intraspecific and intergeneric) and vegetative hybridization, and in directed alteration of hybrids of perennial fruit plants, Michurin not only laid a solid theoretical foundation for revealing the causes of variability, but also pointed to concrete ways of regulating variability with the practical aim of producing economically valuable varieties of agricultural plants.

Michurin said: "Life is an unceasing forward movement of all living organisms that manifests itself in the alteration of the forms and content of organisms that depend on the influence of the constantly changing conditions of environment."

On the basis of thousands of facts testifying to the causes of variability, Michurin gave the following dialectical explanation of this phenomenon: "The time of the existence of living organisms of every form depends both on the structure of the form of the organism and, to an equal degree, on the conditions of the environment in which it develops. And since these conditions change unceasingly through a slow and gradual process and become no longer quite suitable for life, each form is compelled to adapt itself and change its structure so as to continue its existence.... Thus many of the primitive species of organisms that had existed on the globe disappeared altogether, while others, if they survived at all, had changed so much that it is very difficult to recognize in them their old forms."

In his *A Critical Survey of Recent Achievements in Genetics*, Michurin set forth the following thesis:

"Every organ, every property, every limb, all the internal and external parts of every organism are conditioned by its environment. If the plant is organized as it

is, that is because every detail in it performs a certain function, possible and necessary only under the given conditions. Should these conditions change, the function will become impossible or unnecessary, and the organ performing it will gradually atrophy."

The whole history of the development of Michurin's general biological teaching is a history of a fierce struggle against inertness and stagnation of thought, against conservatism and routine and against reactionary and idealistic anti-materialistic conceptions in biology.

What were the points of principle that underlay the struggle in biology between the supporters of Michurin's materialist progressive teaching, on the one hand, and the followers of the Weismann reactionary and idealistic trend, on the other? In a report *On the Situation in Biological Science,* approved by the Central Committee of the Communist Party, to the historic session of the Lenin Academy of Agricultural Sciences of the U.S.S.R. on July 31—August 7, 1948, Academician T. D. Lysenko showed that this "sharp controversy, which has divided biologists into two irreconcilable camps, has thus flared up over the old question: *can characters and properties acquired by vegetable and animal organisms in the course of their life be inherited?* In other words, whether qualitative variations of the nature of vegetable and animal organisms depend on the nature of the conditions of life which act upon the living body, upon the organism.

"Michurin's teaching, which is materialist and dialectical in essence, proves by facts that such dependence does exist.

"The Mendelist-Morganist teaching, which is metaphysical and idealist in essence, denies the existence of such dependence, though it can furnish no evidence to prove its point."

The theory of unity between the organism and the environment, elaborated by Darwin and creatively

developed by Michurin, Williams, and Lysenko, is the only correct materialist teaching which has proved that all living organisms—plants, animals and microorganisms —originated from non-living matter in the process of historical development.

Viewing organisms as inseparably connected with their environment, Michurin worked out highly important scientific postulates on the influence exerted by environment on the process of forming hybrid plants at various stages of their dev lopment. He created a harmonious materialist doctrine of regulating environment with the purpose of directing variation of the nature of vegetable organisms.

The Weismannist-Morganists expressed totally different, reactionary, idealistic views of the relationship between the organism and its environment. In his *Lectures on Evolutionary Theory,* the German zoologist August Weismann tried to prove that there is in organisms a special hereditary substance, enclosed in the nucleus of the germ-plasm.

He wrote: "...The germ-plasm of a species is never generated *de novo*; it only grows and multiplies continually, from generation to generation.... Viewed from the propagation viewpoint only, the germ cells comprise the most important element, for they alone preserve the species, whereas the body is reduced practically to the status of a mere breeding ground for the germ cells, the place in which they form and, under favourable conditions, feed, multiply, and mature."

It follows from th's assertion by Weismann that these "special hereditary substances" represent a separate world, as it were, a world independent of the soma (the body) of the organism and of the environment that surrounds it, of its conditions of life; that the germ-plasm, having once appeared and passing on from one generation to another, remains immortal; while the body of the

organism, being only a breeding ground for the germplasm, dies upon the fulfilment of its functions.

Hence, according to Weismann, every multicellular organism of a plant or an animal represents a double being consisting of different categories of cells—immortal and mortal.

The social nature of the idealists is reflected to the utmost in this imagining by Weismann. In adhering to their world outlook, they cannot do without mysticism and without resorting to attempts at reviving the legend about the divine origin of all living matter, a legend that has been swept away by materialism.

By dividing the whole living organism into two parts, the immortal and the mortal, Weismann tried to arm religion with a "scientific" weapon in its struggle against materialism. Since the nucleus plasm of the sexual cells is immortal, it follows that it has been created by God; this being an act of divine creation, the plasm is invariable, and all the future properties of the organisms are thus predetermined. Consequently, the new characters acquired by organisms in the course of their lives are not inheritable as they have not been predetermined in the "hereditary substance." The mortal body of the organism will die, but the immortal heredity will remain. What is the use then of advanced agrobiology in seed-growing? What is the good of correct feeding and rearing of pedigree cattle? No matter what changes the conditions of life undergo, the hereditary basis of the organisms does not alter, that is, it does not become richer or poorer.

Consequently, the Weismann "evolutionary theory" disarms practical workers in agriculture in their work for high and stable yields of agricultural plants, and for higher productivity of domestic animals.

Academician Lysenko's report *On the Situation in Biological Science* and the speeches by other Michurinists

revealed the theoretical inefficacy, practical sterility, and reactionary character of Weismannism-Morganism.

Michurin's general biological doctrine has proved by thousands of facts that there is no "special," "immortal," or "unchangeable hereditary substance" in vegetable or animal organisms, as the Weismannist-Morganists assert, and that there is no "special" body-regulating apparatus of heredity in the organism.

Heredity is a property inherent in any organism, whether vegetable or animal, and in every part of it; a property conditioned by the whole preceding history of the development of every species of plant and animal. "*Reproduction of similar beings*," says T. D. Lysenko, "*is a general characteristic of every living body.*"

The teaching of I. V. Michurin and T. D. Lysenko on heredity, which proceeds from the principles of materialist dialectics, has irrefutably proved that every organism requires definite conditions for its development, and that every organism possesses an elective capacity for the conditions of life. In the process of historical development a living organism continually obtains from its environment the elements tl at it vitally needs, and, accordingly, acquires its individual, inbred properties and qualities. The conditions of life determine the character of the individual development of vegetable or animal organisms and impart to them the various forms that we observe among one or another species of plants or animals that we name varieties, breeds, etc.

The universal relationship of phenomena in nature is the basis for the development of organic life.

Michurin called environment mother or mentor. Nature has nothing else, nothing supernatural. He had reason to call idealists the opponents of the unity between the organism and its environment, "margarine wiseacres." In his critical note *Environment (Dedicated to Margarine Wiseacres)*, Michurin wrote: "It appears that

Six-Hundred-Gram Antonovka

Bellefleur-Kitaika

Peppin-Kitaika

Michurin Bessemyanka

some people who imagine themselves expert in the laws of the plant world naively question my assertion about the influence of environment on the formation of new forms and species, alleging that this has not been yet scientifically proved.

"... When thinking about such learned men, one does not know what is more surprising: their extraordinary short-sightedness or their crass ignorance and complete lack of sense in their world outlook.

"First of all, it is interesting to know whether they actually believe that all of the 300,000 different kinds of plants originated (excluding any influence of environment) solely by means of hereditary transmission of parental characters? ... Why, such a conclusion would be an utter absurdity. Indeed, it cannot be supposed that the entire vegetable kingdom existing at present originated from the first individual living plant organisms by means of cross fertilization in the course of tens of millions of years, without the influence of the environment, the conditions of which so often and so greatly changed in the course of the centuries and millenniums that have passed...."

In his work of selecting parental forms of plants for crossing and for directed alteration of hybrids obtained from them, Michurin, as a materialist and dialectician, always proceeded from a profound study of plants and of the influence exercised upon them by their environment.

It was only this unfailing rigorous estimate of the law-governed processes of development that enabled Michurin to produce a great number of new and economically valuable fruit and berry, vegetable, industrial and ornamental plants and to elaborate his revolutionary trend in biology.

THE TEACHING ON HYBRIDIZATION

The Mendelist-Morganist theory of hybridization, chained to the non-existing "special hereditary substance" allegedly contained in genes that do not exist in nature either, explains all processes of hybridization from the standpoint of casualty. With Mendelist-Morganists the selection of parental pairs is accidental; the process of fertilization is not law-governed and takes place not on the basis of selection, but on a chance meeting of sexual cells; to regulate the development of hybrid organisms is supposedly impossible.

The Mendelist-Morganists regard hybridization as a method of recombining existing varieties, and not of producing new ones. They reduce the question of hybridization to a mechanical fusion of the properties and characters of two crossed parental forms in a third form. They assert without furnishing any evidence to prove their point, that the offspring of any hybrid can be segregated only by the characters of the parental forms.

This dead scheme of Mendelist-Morganist genetics means that matter moves in a circle, that there is no evolution in nature. It was namely this idealistic conception of development that led the Mendelist-Morganists to the assertion that the phenomena of variability are unknowable and mystically secret and that man is powerless before them. Michurin's teaching on hybridization, on the other hand, is a direct way of getting to know the process of form-building and of regulating this process. It points to the biologist-plant breeder the materialist way of originating new high-yielding and high-quality forms of agricultural plants.

There are three main methods of raising new forms (varieties) of agricultural plants.

The *first method* consists in the mass planting of seeds and in the selection of the best seedlings according to

their economic value. Although in the first stage of his activities Michurin applied this method to fruit and berry plants, he nevertheless considered it least reliable and essentially unacceptable for the purpose. He resorted to it only when, for one reason or another, he had no opportunity of applying hybridization.

"I regard this kind of plant breeding," Michurin said, "as the meanest kind of work an originator can undertake, for only an utter ignoramus can plant haphazardly tens of thousands of plants belonging to one variety and then pick two or three of the best specimens and destroy all the rest. What does man give the seeds of the plants to help them to acclimatize themselves? . . . This haphazard method of acclimatization is not only totally unscientific, but involves the state in heavy and scarcely productive expenditure of forces and funds for conducting the work on these lines."

The *second method* likewise consists in planting seeds, but in this case the seeds are obtained by hybridization and subsequent selection of seedlings possessing more or less valuable economic properties. But neither did this method, too, though more effective than the first, satisfy Michurin.

He said bluntly: "However, although the second method gives the greatest percentage of improved new varieties, it nevertheless does not provide for the utilization of all the possibilities contained in man's interference in the change of the structure of hybrid seedlings."

The *third method*, which Michurin considered as the most effective, consisted in repeated crossing of hybrids and directed training of their seedlings.

Michurin said: ". . . in the work of producing new varieties of fruiters the third method should be regarded as the most important one; it consists in repeated crossing of the hybrids with the best cultivated varieties (including foreign ones).

"By using the third method, it is possible to obtain the best positive results as *most of the details of this method are at the command of man*" (my italics—*A.B.*), and that "...by using this method it is possible to follow a plan of work that has been drawn up beforehand and scientifically substantiated."

Here the plant breeder can intelligently interfere in the actions of nature by creating conditions of life that would regulate the development of the hybrid plant in the desirable direction.

"True enough," Michurin said, "here, too, hybridization gives us embryos of an organism with as yet unknown properties, but we can influence this organism in its further development by applying purposeful training."

Purposeful training, whereby the biologist-plant breeder can implement his creative role in using the "struggle" of opposites in the growing hybrid organism, underlies Michurin's thesis on hybridization.

Thousands of facts convinced him that inner contradictions are inherent in all phenomena of nature, including the growing hybrid plants, and that the "struggle" of opposites within every organism constitutes the process of development, and Michurin waged a long and persistent struggle against the Mendelist views on these phenomena. In his *Principles and Methods* he wrote: "...the results obtained from the crossing of the same pair of progenitors will never be repeated twice; in other words, if we cross a pair of plants and obtain hybrids with a combination of certain properties, no matter how many times we repeat the cross with the same plants, we shall never obtain hybrids of the same structure. Even the seeds in one and the same fruit obtained from the cross give rise to seedlings of completely different varieties. It is evident that in creating new forms of living organisms nature gives rise to infinite diversity and never permits repetition."

In the same work, Michurin reverts to this question again: "... when a breeder fertilizes a flower of a chosen variety of fruit plant with the pollen of another variety he obtains from the seeds of one and the same fruit seedlings of different types, which manifest not only the characters of their direct and immediate parents, but also the characters and properties of both near and distant kin of the parent plants which are in most cases altogether unknown to the breeder; to this must be added the changes that arise under the influence of external factors as well as of the diverse sport bud deviations.

"The question arises, in what way under such conditions can Mendel's law or the hypothesis of the role of the chromosomes help in the matter?"

Finally, in an article *Mendel's Law is Inapplicable to Fruit Growing*, Michurin said indignantly: "And, lastly, let all those who ardently support the application of Mendel's laws to all forms and species of living organisms without exception, get out of their studies and do some practical work by crossing two cultured varieties of fruit trees chosen at random, the Borovinka and Antonovka apple trees, for instance; let them raise seedlings from the seeds they would thus obtain and then let them see the result. Will they find in these seedlings equal deviations to the Antonovka and Borovinka varieties, as Mendel's law says they would? Naturally, they will not. With simple rearing, so usual in fruit gardening, all the seedlings assume the wild forms of our forest crab apples. This indisputable fact has convinced all fruit gardeners that almost in every case only wildings can be obtained from the seeds of cultured varieties of fruit trees.

"Such a conviction is, of course, a gross mistake, because, firstly, the required cultured properties in the seedlings may and do manifest themselves not only as a result of the transmission of inherited genes (characters) from the progenitor plants, both paternal and maternal,

but mostly as a result of such transmission from more distant kin; secondly, an extremely important role is played by the external conditions in which each seedling develops, and the regime of its training."

Rising against the fatalist scheme of the Mendelists, Michurin wrote that Mendelism "...contradicts intrinsic truth in nature which no artificial combination of mistakenly conceived phenomena can withstand. It would be desirable that a thoughtful, unbiassed observer should dwell on my conclusions and personally verify the truthfulness of these conclusions. They are the foundation that we bequeath to the naturalists of the coming ages."

Many years of profound research into intravarietal and intervarietal hybridization not only confirmed Michurin's thesis, but also enabled T. D. Lysenko to arrive at a momentous theoretical conclusion in this field.

"A hybrid," T. D. Lysenko said, "is an integral organism. It contains no division into paternal and maternal potentialities of development. It possesses all these potentialities, but it develops in the directions for which the given environmental conditions are best suited."[1]

And now we may proceed to give an exposition of Michurin's principles and methods of hybridizing plants.

METHOD OF SELECTING PARENTAL FORMS FOR CROSSING

When selecting the parental forms for a cross, it is necessary to know the hereditary basis of the maternal and paternal plants. Michurin's theoretical opponents, the Mendelists, always compared the hereditary features (characters) of the adult progenitor forms with those of the adult offsprings and in this way judged their heredity. Michurin, on the contrary, treated the selection of pa-

[1] T. D. Lysenko, *Agrobiology,* Eng. ed., Moscow 1954, p. 151.

rental forms from the standpoint of materialist dialectics; he regarded all the characters in the process of development of the progenitor and offspring organisms as depending upon the conditions of life. He wrote: "... for an intelligent choice of plants for crossing one must know the qualities of the plants' parents; only then can one act, not at random but with a more or less certain expectation of obtaining desired combinations of properties and characters in the seedlings."

Michurin ascertained that if a hybrid develops in the same conditions as those in which the mother variety formed and propagated for many years, it will manifest mainly maternal characters. On the other hand, if the hybrid develops under conditions similar to those of the life of the father variety, paternal characters will predominate.

Through numerous facts obtained as a result of his work in sexual hybridization, Michurin found that old, long existing varieties of fruit plants possess a stronger capacity for transmitting their characters than young, recently cultivated varieties. That is why the hybrids that are obtained from crossing plants of old and young varieties, are, in most cases, similar to the progenitors of the old variety.

Michurin noted that *wild* plants, being *older in origin,* possess a stronger capacity for transmitting their characters to the hybrid offspring, and that *older* parental forms (regardless of sex) likewise possess a stronger capacity for transmitting their properties to hybrids, these being biologically law-governed phenomena.

On the basis of the laws of inheritance of characters discovered by him, Michurin worked out his method of purposeful selection of parental forms for sexual crossing.

The scientific foundations of Michurin's theory of hybridization require that parental forms should be chosen according to the following three principles:

1. Place of growth (geographical distribution)
2. Age and individual vigour
3. Advantageous economic properties and qualities.

The gist of these principles is as follows.

The *first principle* is substantiated by Michurin in that the more "...distant are the parent plants used in the cross with respect to place of origin and environment the more easily adaptable will their hybrid seedlings be to the external conditions of the new locality."

Michurin explains this principle by the incontestable fact that the properties and characters of the female or male parent forms and of their next-of-kin, transmitted to the hybrids by heredity, will be unable to exert a unilateral domination too strongly when passing these properties to hybrids in the new conditions of life, as they are no longer in the usual environment of their place of origin.

Let us cite the following example. Michurin crossed southern varieties of winter pears with our Limonkas and Tonkovetkas with the purpose of breeding a variety of pear trees bearing winter-ripening fruit that would be new to the orchards in the central belt. The hybrids bore better-flavoured fruit, but it was small and ripened early. This was due to the dominance of the properties and qualities of our local varieties, for the development of which the external conditions (soil, climate, moisture, etc.) are appropriate and usual.

The experience gained in raising the Michurin Beurré Zimnaya (Winter) variety of pear may serve as a classical example to demonstrate graphically the effectiveness of Michurin's teaching on the selection of parental forms of distant geographical origin, and of the law of the dominance of characters that he discovered.

Michurin's choice of a maternal plant fell on a wild Ussurian pear (Pyrus Ussuriensis Max) of Far Eastern origin, a tree that was new to his orchard; he pollinated its blossoms with the pollen of the Beurré Royal pear, a

Kandil Kitaika and its parental forms

Reinette Bergamotte

southern variety. From the hybrids thus obtained he selected the best form, which proved to have remarkable properties: complete frost-resistance in the Tambov and even in the Moscow regions; immunity of the bark to burns; resistance of the flowers to spring frosts; immunity to fungus diseases and to pest attacks; yearly generous yield; solid fastening and uniformly large size of the fruit, its fine colouring and excellent flavour. The most noteworthy property of the hybrid was that its fruit began ripening in November-December, and under normal conditions of winter storage it kept till March or April.

The hybrid was the first of a variety called Michurin Beurré Zimnaya and it is still the only winter variety of pear in the central belt of the European part of the U.S.S.R.

The crossing of geographically dissimilar varieties that subsequently develop in a new environment leads to variability which the biologist-plant breeder tries in every way to induce. *The variability of such hybrids is due to the fact that the new conditions of life in which they came into existence enhance the possibility of their adaptation to these conditions in the process of their ontogenetic (individual) development....*

Michurin produced most of his famous varieties of fruit and berry plants by crossing (hybridizing) geographically dissimilar forms and by directing the development of the hybrids.

Thus, by crossing the Kitaika apple (mother plant, of North China origin) with the Kandil Sinap (father plant, of Crimean origin), Michurin produced his superior Kandil-Kitaika variety.

By crossing Bellefleur Zholty (mother plant) with Kitaika (father plant), he raised Bellefleur-Kitaika, another remarkable apple variety.

The crossing of Reine Claude Zelyony plum (mother plant; origin—Italy and Hungary) with blackthorn-plum

(father plant; origin—Southern and Eastern Europe) resulted in the Reine Claude Kolkhozny plum variety.

By crossing Vladimirskaya sour cherry (mother plant; origin—the town of Vladimir) with the Winkler white cherry (father plant; origin—the Crimea), he produced Krasa Severa, one of his most famous cherry varieties.

By crossing Chasselas grape (mother plant; origin—Spain) with Canadian Wild (father plant; origin—Canada), Michurin raised a new variety of grapes, Severny Byely (Northern White).

Michurin's *second principle* on the necessity of choosing progenitor forms according to their age and individual vigour is substantiated by the fact that the vitality of the hybrids depends on the age and health of the parental plants. For this reason Michurin did not recommend the use of parent plants that were too old or diseased. He likewise avoided using for crossing purposes such antiquated and degenerating varieties as the Saint-Germain pear or our Chornoye Derevo (Black Tree) apple. Neither did he consider as reliable trees grafted on to stocks of low stature such as the short Siberian apple tree. Michurin regarded as quite unsuitable for this purpose trees for which the stock is chosen from among plants of different species as for example, pears grafted on quince, hawthorn or mountain ash; sour cherries grafted on Antipka (Mahaleb cherry); plums grafted on apricots. Likewise unsuitable, in Michurin's opinion, was grafting on stock that had been cultivated for ages by cuttings, and not by seeds, as this stock had lost its capacity for sexual propagation such as layer Paradizka (Pyrus Malus paradisiaca hybr. Michurin), blackthorn, etc. Inappropriate, too, according to Michurin, were trees grafted on to the crown of an adult wilding.

In this connection Michurin advises that "in general, the innovator must pay serious attention to the root system of the maternal plants from which the seeds are to be

taken, and he must remember once and for all that the roots of every plant take an active part in the production of its seeds, precisely in the sense that they affect their formation and lay down the basis for the qualities and properties of the future plants."

In choosing the parental forms, Michurin attached great importance to the age and individual vigour of the maternal plant, and always preferred own-rooted plants and particularly those that blossomed for the first time.

He did not, however, consider these rules dogmatic. Whenever he had to eliminate the dominance of undesirable characters of one of the progenitor forms, he even resorted to artificially weakening it by drying the soil, baring a part of the roots, pruning the stem root (of a rose), etc.

Michurin's *third principle* on the necessity of selecting parental forms according to their positive properties and qualities is the most essential as it ensures the breeding of new varieties with foreseen economic features.

INTRASPECIFIC HYBRIDIZATION

Michurin extensively applied intraspecific (intervarietal) hybridization with subsequent purposeful training of the hybrids to produce new varieties of fruit plants bearing fruit of desired properties.

When he decided to raise for the central belt of Russia a new frost-hardy variety of apple tree whose fruit would not be inferior to the Crimean Kandil Sinap, Michurin selected the Kitaika, an own-rooted tree that had broken into blossom for the first time, and the Kandil Sinap as the mother and father plants respectively. The Kitaika is a very hardy, frost-resisting tree but the fruit it bears is small and poor-flavoured. The Kandil Sinap, an apple tree native to the Crimea, bears excellent fruit, but perishes from a frost of 20° Centigrade below zero. The

Kitaika grew on open ground in Michurin's orchard, while the Kandil Sinap grew in a barrel which in the winter was moved to a basement or a shed. In spring, when the Kitaika bloomed for the first time, he carefully opened the blossoms with tweezers and removed all the anthers (male reproductive organs); in other words, he castrated the flowers. In order that no bee or any other insect should transfer to it the pollen of some undesirable variety of apple after the flowers had opened, thus interfering with the planned experiment, he isolated the castrated flowers with gauze bags (isolators). Simultaneously, he prepared some pollen from the flowers of the paternal variety of the plant, the Kandil Sinap, which he placed for a day or two in a special contrivance called a desiccator to let it mature. A day or two later, he removed the isolator from the Kitaika flower which was now ready for fertilization, and with a piece of rubber he took some pollen of the Crimean apple from a jar and put it on the stigma of the Kitaika. Then he again covered the flower with the isolator. Rapid petal dropping showed that the process of fertilization had taken place. On a branch under the isolator Michurin hung a tag marking the variety of the father plant, the pollinator, and the date on which the cross had been made. Until the fruit matured Michurin checked its growth every fortnight.

In autumn the seeds chosen from these fruit were planted by Michurin in boxes, and in spring the seedling thus obtained were planted in beds.

By this intraspecific (intervarietal) hybridization and directed training of hybrids, Michurin raised an apple variety which by its flavour and capacity for keeping fresh (the fruit can be kept till the middle of June in conditions of cellar storage) is superior even to Kandil Sinap. In this way he raised most of his famous varieties of apples, pears, plums, sweet cherries, sour cherries, grapes and other economically useful plants.

DISTANT (INTERSPECIFIC AND INTERGENERIC) HYBRIDIZATION

After his successful experiments in intraspecific hybridization, Michurin aimed to control the form-building process of plants with a view to raising winter-hardy varieties of apricots, peaches, sweet cherries and other plants. He arrived at the conclusion that it was necessary to apply interspecific hybridization (the crossing of the *least closely related* plants such as sour cherry with bird-cherry, mountain ash with pear, pear with apple, apricot with plum, sweet cherry with sour cherry, etc.).

While striving to control the form-building process, Michurin did not, however, regard distant hybridization as an end in itself to produce a diversity of forms.

Michurin approached distant hybridization from the viewpoint of at least three fundamental principles of biology which afford the plant breeder more opportunities of regulating the variability of the heredity of living organisms.

The *first principle* consists in the emergence of new properties and qualities in hybrids, i.e., of variability of heredity resulting from adaptability to the conditions of life. The following facts from Michurin's experience will serve to corroborate this principle.

In 1900, Michurin used the Niedzwetzkyana apple tree (possessing red leaves, red flowers and small almost inedible fruit with red flesh) for the maternal form, and crossed it with the Antonovka (paternal form). He obtained hybrids, with some seedlings having red leaves and others—green leaves; however the shoot and leaves of one of the seedlings were red on one side and green on the other.

The first fructification showed that all the hybrids with the red leaves produced winter-ripening fruit of

approximately the same size and flavour but twice as large as that of the mother plant (the Niedzwetzkyana apple tree). The hybrids with green leaves bore fruit of various shape, size, and colouring (light and many-coloured) with a flavour ranging from quite sweet to rather sour and having nothing in common either with the Niedzwetzkyana, the maternal plant, or the Antonovka, the paternal plant.

As is well known, Lilium Szovitsianum Fisch and Lilium Thunbergianum Schult do not, to any degree, possess the fragrance of violets. By crossing these two species of lilies, Michurin obtained, however, a lily of a new variety with lilac flowers that had a well pronounced fragrance of a violet. He named it the violet lily.

The *second principle*, Michurin points out, consists in that the hybrids, besides possessing new properties and characters as a result of distant hybridization, "...give rise to the more vigorous and sturdier individuals." Michurin's Cerapadus No. 1, produced by crossing the Samara steppe sour cherry (maternal form) with the Japanese bird-cherry (paternal form), is one of the many noteworthy instances of the appearance among other interspecific hybrids of individuals noted for their greater vitality. Along with absolutely new properties, such as a special character of leaf-dropping and drastic changes in the shape of the leaves, floscule and colouring of the bark, the Cerapadus No. 1 strongly manifests heterosis, i.e., a faster rate of development which is observed in the first generation.

The *third principle* consists in better adaptability of distant hybrids to the conditions of life.

As Michurin put it, "it must be firmly borne in mind that it is the interspecific hybrid that possesses the greatest capacity for adapting itself to new conditions of environment."

It must be said again that neither intraspecific nor

interspecific hybridization was an end in itself but a means of "destabilizing" the heredity of the progenitor plants, a means of "knocking," in Michurin's own words, the organism of the plant out of its "accustomed" state and making it more pliable and plastic for directed alteration and for the cultivation of a new valuable variety.

However, to cross least closely related species of plants, it is necessary to find ways and means to overcome the resistance to crossing. Michurin's methods are precisely such ways and means. He was the first to introduce them into biology and plant-breeding experience, and these methods are: "intermediary," "preliminary vegetative approximation," "pollination by mixed pollen," and others.

Let us analyze the essence of these methods.

THE "POSREDNIK" (INTERMEDIARY) METHOD

The elaboration of the "posrednik" method is connected with Michurin's work in producing a frost-resisting peach tree. This was his cherished goal.

There did not exist a variety of peach that could winter in the conditions of the central belt of Russia. Neither was there such a cultured form of almond (which is the next-of-kin form of peach) that could withstand the winter in that belt. There was, however, a cold-resistant species of almond called the "Bobovnik" (Amygdalus), which grew under the conditions of the central belt, but it did not cross with the peach tree.

Consequently, Michurin, eager as he was, could not find parental forms to obtain winter-hardy hybrids, either between two species of peach or between peach and almond.

After a tireless search Michurin finally found the appropriate forms. These were the wild David peach,

growing in China, and the tall Mongolian variety of the wild almond. Michurin knew, however, that, as a rule, pure species of plants of distant relationship lent themselves to hybridization with much greater difficulty than young hybrid plants. First Michurin crossed these two closely related forms David peach and "Bobovnik" almond and obtained an "intermediary link of the plant"—a new hybrid form of almond which he named "Posrednik" ("Intermediary").

It was this hybrid "Posrednik" variety of almond that became the intermediary link, or the "intermediary," which, owing to the "destabilization" and plasticity of the hereditary basis greatly facilitated the task of obtaining a winter-hardy strain of peach in the climatic conditions of the central belt.

It follows from this that when it is impossible to effect a direct cross of two species of plants, one should first produce an intermediate hybrid form, an "intermediary," which, due to the "destabilization," and plasticity of the hereditary basis, lends itself to crossing with another species of a parent plant with greater ease.

The "Posrednik" method was later applied by Michurin's pupils and followers to obtain almond-peach, plum-apricot, sour cherry-sweet cherry and apple-pear hybrids.

THE METHOD OF "PRELIMINARY VEGETATIVE APPROXIMATION"

This method is of great scientific and practical significance as it facilitates the crossing of least closely related species of plants. It offers the plant breeder considerably greater opportunities to direct the variation of the properties of a grafted plant (the scion) under the influence of the stock (the plant on which the grafting is effected).

Direct crosses of forms of plants as distantly relat-

ed as the apple and the pear, the quince and the apple, the apple and the mountain ash, the mountain ash and the pear, the quince and the pear usually end in failure. It is only the application of the effective Michurin method of "preliminary vegetative approximation" that makes it possible not only to overcome the resistance to crossing of distantly related plants, but to obtain from them hybrids that bear fruit regularly.

The method consists in the following: cuttings of one-year-old hybrid seedlings are grafted onto a branch of the crown of a mature tree of a different species or genus, as, for example, a pear on an apple, a mountain ash on a pear, a quince on a pear, an almond, apricot or peach on a plum, etc. The grafted cuttings continue to develop in the course of the next five or six years under the constant influence of the work of the entire leaf system of the tree to which they have been grafted, and by virtue of this they partially change their structure. When the first flowers appear on the grafted cuttings, they may be pollinated by the pollen collected from the flowers of the tree on which the cuttings grow. It is expedient to pollinate the flowers of the tree on which the cuttings have been grafted by the pollen collected from the flowers blooming on the grafted cuttings. "Pollination (crossing)," Michurin pointed out, "is much more likely to succeed in such cases, because by the time the crossing is performed the plants have developed a mutual affinity in their vital functions."

But it was not in overcoming the resistance to crossing that Michurin perceived the significance of his method of "preliminary vegetative approximation."

The long process of reciprocal action of two different organisms grafted to one another, inevitably, and in accordance with biological laws, leads to profound radical changes in the organism of the scion and, naturally, leaves some traces on the stock as well. Michurin discerned

in this interaction the power not only of sexual, but of vegetative hybridization, too, which is a new weapon in building forms of plants needed by man.

"The seedlings obtained from the sprouting of the seeds from such hybrid fruits," Michurin said, "already represent real hybrids of plants of two different species, and the seeds of such hybrids are almost always quite normally developed, giving a fair percentage of germination. Furthermore, a large number of different variations appear in the second generation."

On the basis of his research and the remarkable results he received from the application of the method of "preliminary vegetative approximation," Michurin arrived at the conclusion that this method makes it possible to obtain hybrids between apple and pear, almond and plum, almond and peach, apricot and plum, bird-cherry and sour cherry, mountain ash and pear, apple and hawthorn, and quince and pear.

"*An infinite prospect opens here*," Michurin said, "*for the possibility of obtaining entirely new species of fruit plants with unprecedented forms and properties.*"

Taking into account the important national economic task of raising new cold-resisting and high-grade forms of pear trees bearing winter-ripening fruit, and of extending this variety to the north-eastern regions of the U.S.S.R., the Michurin Central Genetics Laboratory has raised more than 1,000 apple and pear hybrids by methods of "mixed pollen" and "preliminary vegetative approximation." A major part of these hybrids have already entered the phase of fruit-bearing. Hybrids of great scientific interest include promising forms which, after repeated crossing, will render it possible to solve successfully the task of obtaining new economically valuable varieties of pear trees for the central and north-eastern parts of the Soviet Union, and possibly of producing quite new species of fruit plants.

THE USE OF MIXED POLLEN

Michurin often carried through exceedingly difficult interspecific crosses successfully by adding a very small amount of pollen from the maternal plant to the pollen of the male plant. This "... helped better to stimulate the stigmas of the pistils," particularly if the stigma was of a somewhat complex structure. "When the mentioned method is employed there forms on the stigmas a substance peculiar to each species of plant, which helps the pollen grain to germinate." Michurin worked hard to produce new varieties of attar roses. When, as was often the case, different species of this plant resisted crossing, Michurin applied a new original method. To overcome this resistance, he decided to mix the pollen of several paternal progenitors, adding to the mixture a small quantity of pollen from the maternal plant. Pollination with mixed pollen gave quite unexpected results; pronounced successes were scored where formerly failures had dogged attempts to cross selected varieties of plants.

In *Pollination with Mixed Pollen*, Michurin says that the pollen of the female plant "... probably has greater power to stimulate the pistil for the act of fertilization, and, possibly, introduces alien pollen as well."

Further, Michurin said: "... to make this act of fertilization successful, the pistil must be brought, so to speak, into a state of stimulation by covering it with pollen of its own species.

"The pollen of other species is evidently unable to stimulate the pistil. Apparently it is in this way that nature tries to preserve species in relative invariability."

To explain this phenomenon, Michurin set forth the following thesis: "... as we know, all species and even varieties of one and the same species possess pollen of a different odour, and the essential oils contained in the

pollen of every variety are precisely the stimulants of the pistil. . . ."

In his lecture *Ways of Controlling Plant Organisms*, Academician Lysenko cited the following experience dealing with the elective capacity of fertilization. A. A. Avakyan, a well-known biologist and plant breeder at the experimental station of the Lenin Agricultural Academy in the Moscow suburb of Gorki Leninskiye, obtained an unviable offspring after pollinating Gostianum 0237 wheat with the pollen of the 1160 variety. The Morganist geneticists wrote this off to the influence of the so-called "lethal genes."

But no sooner had A. A. Avakyan added some of the pollen of the maternal plant of the Gostianum 0237 wheat, than the offspring thus obtained proved to be quite vital.

"This shows," T. D. Lysenko said, "that exchange of substances can take place between different varieties of pollen if a mixture is placed on the stigma, or between the pollen of different varieties and the egg cells of the mother plant. The physiology of these processes has not been investigated, but at all events it is an indisputable fact that the result of pollination with mixed pollen was different from that when the pollen of only the 1160 was used. Michurin pointed to the advisability of mixing pollens. In this way he succeeded in crossing species and genera that could not interbreed otherwise."

Viewing the elective capacity of fertilization as a phenomenon of the adaptability of plants that took shape in the course of history, Academician T. D. Lysenko dealt a crushing blow to the assertion of the Mendelist-Morganists that fertilization is "casual." As he put it, "every process that takes place in an organism possesses relative elective capacity. The sexual process also possesses this elective capacity, and the assertion of the Mendelist-Morganists that fertilization is purely accidental, that it takes place only according to the law of probability, is,

of course, totally inacceptable to anybody who knows anything at all about biology."[1]

It was only a materialist dialectical outlook, an untiring search and profound investigations into the processes of fertilization that enabled Michurin to make such a highly important discovery in the biology of plants, as the method of using mixed pollen.

It was not the Morganist impotence and disbelief in man's ability to interfere in the process of the fertilization of plants, but the Michurinist intelligent interference in this process that helped to produce new forms of plants needed by socialist agriculture. The process of fertilization is due not to the Morganist "casual" mating of sexual cells, but to a definite biological law that the biologist-plant breeders have to know and learn to regulate. It was Michurin's materialist dialectical principle of the laws of development, and of the unity between the organism and environment, and not the Morganist chaos of accidental, unrelated phenomena allegedly taking place in nature independently of any connections or laws, that has made it possible to convert biological science which explained the development of vegetable and animal organisms into a science regulating their development.

DIRECTED ALTERATION OF THE NATURE OF VEGETABLE ORGANISMS

Michurin pointed out that obtaining hybrid seeds is the beginning, and not the end of the plant breeder's work. Michurin's teaching is based precisely on the need of giving the hybrid seedlings directed training, i.e., of creating the conditions best suited for their development so as to make them manifest the most useful characters and eliminate those that are undesirable.

[1] T. D. Lysenko, *Agrobiology,* Eng. ed., Moscow 1954, p. 294.

Seedlings obtained from seeds of definitely economically valuable progenitor plants may, in ninety-nine cases out of a hundred, produce altogether unfit wildings if they are bereft of rearing and training, and planted in a soil poor in nutrient substances.

"Subjected to an incorrect training regimen," Michurin said, "the very best hybrid of cultivated varieties is liable to degenerate into a complete wilding, and, conversely, by employing proper training methods on a cultivated hybrid seedling with rudiments of undesirable characteristics, we may retard the development of these bad qualities and, in some cases, even eliminate them altogether and thus obtain a good new variety."

In order to produce the best varietal characters in a hybrid plant, or economically more valuable characters in domestic animals (early maturity of a breed, daily gain in weight of pigs, higher milk yield of cows, greater fleece weight of sheep, etc.), it is necessary to create better conditions of feeding.

Darwin pointed out: "... it is almost certain that abundant food given during many generations directly affects the size of breed.... Aided by more abundant food, all the lowland British breeds have increased greatly in size and in early maturity since the reign of Henry VII."[1]

The increase in size of many breeds of domestic animals under the influence of better food and care, naturally left some trace on their hereditary basis. As a result of better food and care the hereditary basis of animals changed in the direction of their greater productivity.

Citing many facts from hybridization experience, Michurin demonstrated that hybrid plants originated by the same progenitors and vegetating under equal conditions behave differently and manifest quite different forms

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[1] Charles Darwin, *The Variations of Animals and Plants Under Domestication*, London 1890, pp. 95-96.

of heredity variability. Sometimes there are differences not only in the external and internal qualities of the whole vegetable organism but even in its individual branches, and what is more, in every and each bud. Michurin said that these phenomena are due to the law of individual development of every vegetable organism. Therefore, the approach in creating conditions of life for the hybrids must not be indiscriminate or mechanical. By influencing the growth of hybrids obtained from the cross of a cultured plant and a wilding, Michurin proved that favourable meteorological and soil conditions bring out the positive characters of the cultured parent, and, conversely, unfavourable meteorological and soil conditions bring out the negative characters of the wilding progenitor.

The properties of every hybrid grown from seeds, Michurin pointed out, consist of a combination of properties inherited from the parent plants and their kin—properties whose development was favoured by environmental conditions at the earliest stage of the hybrid growth. "Environment" includes the composition of the soil, the temperature of the air and soil, the sum total of atmospheric electricity, the presence of a sufficient quantity of carbonic dioxide in the atmosphere, the direction and force of the wind, the degree of light, humidity, etc.

Observing the non-recurrent nature of hybrids received from the crossing of one and the same parental pair of plants, Michurin indignantly denounced the Mendelists, who presumptively tried to squeeze into Mendel's "pea law" the great multiformity of life's phenomena in vegetable and animal organisms. Michurin wrote: "It is evident that in creating new forms of living organism Nature gives rise to infinite diversity and never permits repetition."

This shows that each plant develops individually.

Michurin profoundly investigated plant organisms and their external conditions, and worked out the teaching of

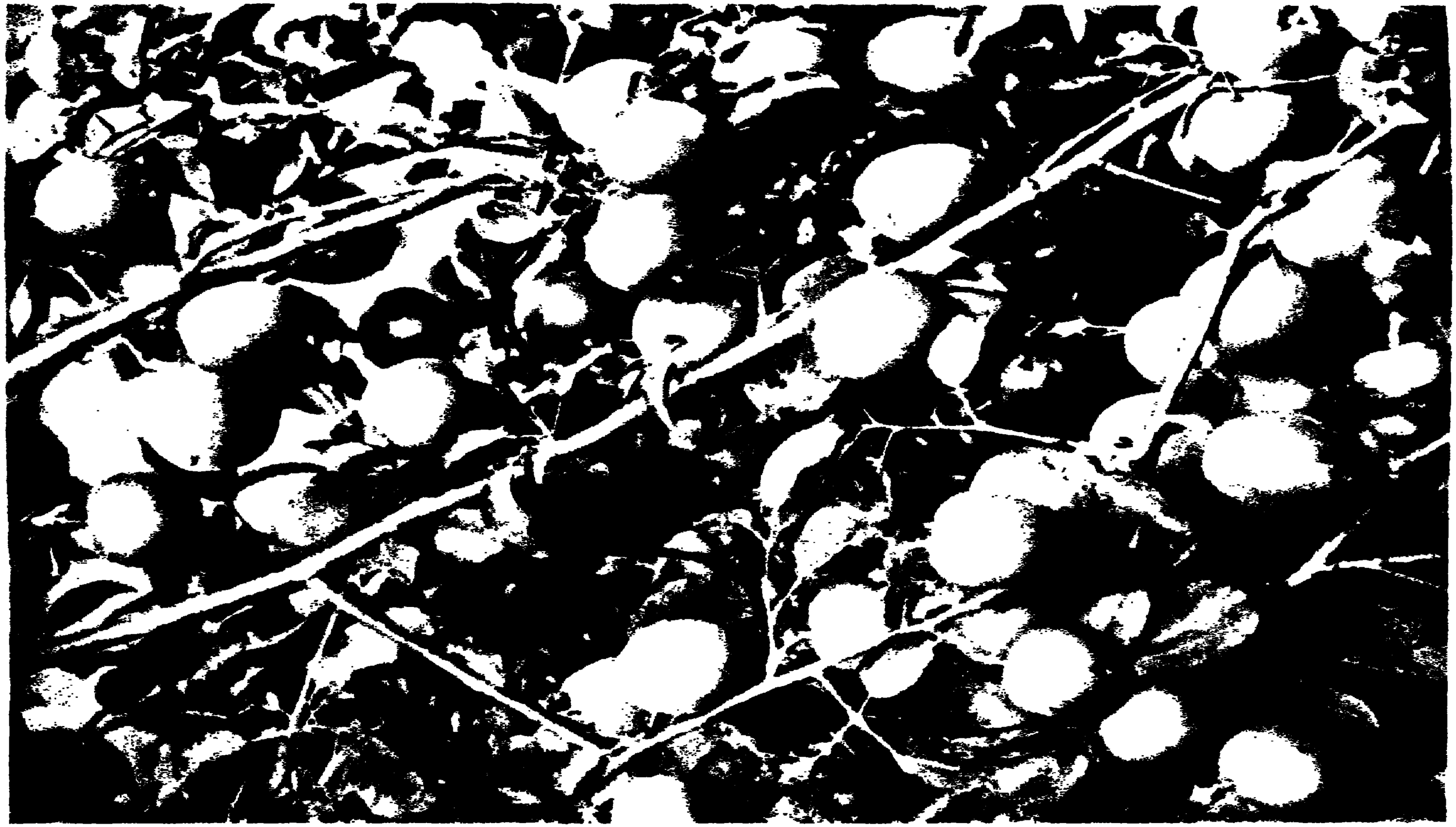
regulating their individual development by creating conditions of life that would favour the promotion of economically valuable characters. He strongly objected to a mechanical approach to any individual plant. He knew exactly in what cases it was expedient to increase or decrease the quantity of nitrogen of mineral fertilizers or moisture; the conditions under which the soil should be kept; when and what mentor should be supplied to attain winter-hardiness, higher yields, larger fruit, etc.

The Mendelist-Morganists asserted that the hereditary basis of the offspring is not affected to any degree by the conditions of the parental forms, no matter if they are strong or feeble, or if their economically favourable or unfavourable characters are developed to a greater or lesser extent.

These anti-scientific assertions of the Mendelist-Morganists were very detrimental to plant breeding and seed growing, to the production of new high-yielding plants and highly productive breeds of domestic animals. When he trained hybrids, Michurin strove to improve their varietal properties and did everything he could to make dominant their most valuable characters. He placed the hybrids in conditions that favoured the development of their most valuable characters and the elimination of undesirable properties, thereby regulating their quality of dominance and controlling the process of the formation of the varietal nature of hybrids.

Michurin would begin regulating the quality of dominance long before the hybrid was obtained, doing this, as has been already said, by properly selecting the parental forms.

However, after he had selected the proper pair of progenitor fruit plants, Michurin would extend this principle of proper selection to the flowers on the mother tree, i.e., the flowers needed for the cross. He pointed out that flowers growing nearer to the main vertical branches of



Peppin Shafranny

Beurré-Pobeda

the trunk "... give better hybrids with larger-sized fruit but such that tend to deviate considerably in structure in the direction of the maternal plant, and, conversely, flowers on the horizontal branches, placed nearer to the periphery of the crown generally give hybrids with fruit of smaller size and that deviate in the direction of the male parent."

The following facts illustrate the way Michurin controlled mutability, i.e., directed the alteration of fruit plant hybrids in a manner desirable for the national economy.

1. To obtain the most valuable hybrid seeds of, for example, the apple or the pear, Michurin did not extract them out of the fruit at once; he kept the fruit in storage as long as possible to let the seeds reach their fullest development on the nutritive substance of the flesh.

2. The air, as we all know, contains a rather limited quantity of carbon dioxide: only 0.03 per cent. Yet carbon dioxide is particularly indispensable to every young vegetable organism in the course of its life. For this reason Michurin chose low, sheltered spots in which to plant hybrid seeds and cultivate hybrid seedlings. Carbon dioxide is heavier than air and keeps longer in such places and, consequently, is better assimilated by the leaves, while on elevated exposed spots it is carried away by the wind.

3. To regulate the development of hybrids obtained by crossing the Stepnaya Samarskaya sour cherry with the Vladimirskaya (Roditeleva) sour cherry in the direction of the Vladimirskaya (Roditeleva) cherry, Michurin had a quantity of soil sent to him from Vladimir, the home of that cherry. In other words, he made available for the hybrids the home soil of their maternal progenitor.

4. To raise a new variety of pear with a higher sugar content, Michurin created exceptionally favourable conditions to produce a greater sugar accumulation capacity in a hybrid seedling, which he obtained in 1906 by crossing

the Tsarskaya pear with the Idaho pear. On a plot of two square metres of rich river alluvium consisting of deep peat and clay he introduced two kilograms of quick-lime, six kilograms of horn-dust (a very strong organic fertilizer) and 128 grams of Chilean saltpetre. Besides, every spring, he added a liquid fertilizer composed of pigeon droppings and quick-lime, and after fertilizing the soil did some deep hoeing around the stem every fortnight, mulching it with a five-centimetre layer of hotbed manure.

Furthermore, with a syringe he injected three c.c. of a 14 per cent sugar solution (in distilled water) into the upper layers of the pulp under the bark. The quantity of the solution was increased as the seedling grew, the operation being repeated in the course of five years beginning with the first year of development of the hybrid seedling.

The effect on the organism of the hybrid pear proved most beneficial for the realization of Michurin's idea. The sugar content in the fruit of the pear tree, which he called Surrogat Sakhara (Sugar Substitute), was unprecedented. A 128-gram pear, when pressed, produced 13 grams of highly fragrant glucose.

By this experiment Michurin proved that artificially altered food conditions of the hybrid greatly influence the change of the hereditary properties of the organism in the desired direction.

5. By training on rich garden soil some seedlings which he raised from the seeds of an old Central Russian variety of the Skrizhapel apple, Michurin originated two new outstanding varieties—Oleg and Truvor, the fruit of which was almost double the size of the ordinary Skrizhapel and had a better flavour than the maternal plant.

Describing the Truvor apple variety, Michurin said: "... the best qualities of hybrid seedlings, external as well as internal, depend on the rational rearing of the

plants, i.e., on the wise and expedient care and to a considerable degree on the quality of the soil, good nutriment, etc."

6. Wishing to produce a new variety of yellow rose by crossing the Persian Yellow rose with the Rosa Cuberta, Michurin used the most diverse methods to influence their organisms in order to overcome their resistance to crossing and to make them change in the direction he desired. He carefully pruned the stem root of the mother plant (Persian Yellow) after buds had appeared and pollinated the flowers of the rose before they blossomed. When florescence began Michurin heated the soil around the plants, covered it with all kinds of mulch, poured hot water over it, put hot bricks around the plants at night, at which time he also pollinated the flowers. Furthermore, he wetted the pollinated flowers with distilled and rose water, removed all the petals from buds that did not open, bending the blossoming buds to the ground and covering them with cone-shaped bell-glasses.

In this way Michurin raised his new variety of rose which he called the Tatyana Michurina; its flowers are of a golden-yellow colour.

7. Michurin applied electrization of the soil to accelerate the development and shorten the vegetative period of grape and peach seedlings. The action of a weak electric current produced quite favourable results.

He used rich black-earth soil for some plants, poor sandy soil for others, and clay soil with or without lime for still other plants. To some soils he added powerful organic fertilizers such as manure, peat, horn- or bone-dust, while for other soils he used mineral fertilizers. Some plants were given abundant moisture, others received little of it. He used thick wooden light-proof chambers to shorten the day for plants accustomed to a short day (these included plants from the Far East, Central Asia, the Caucasus, and the Crimea). Apricots,

peaches, grapes, soya-beans, and other plants were experimented on in this way. Every factor influencing the plant organisms was applied by Michurin discriminately, depending on the biological features, requirements and age of the plants.

It has been pointed out already that by able and diverse training Michurin induced vegetable organisms to change their heredity. Such training helps to reveal all the favourable properties of a variety and ensures generous yields; this is a salient point of Michurin's teaching. But it is noteworthy that Michurinist training is not blind and does not imply that the young hybrid organisms should be servilely humoured. T. D. Lysenko said that good and able training does not mean only "patting on the back." It is sometimes necessary to go "against the grain."

Michurin's method of training hybrid seedlings is a decisive factor for success. That is why every plant breeder should be constantly concerned about the choice of the soil, lighting, providing plants with moisture, raising the fertility of the soil, giving the plants better care, and taking timely agricultural and technical measures.

In his *Rules for Training Hybrids*, Michurin said: "It is precisely here that man has one of his greatest opportunities to impose his will on the structure of the hybrid and make it deviate in one direction or another by controlling the action of the factor concerned."

Michurin had profound faith in man's creative powers and paid tribute to the human mind for its capacity to fight unfavourable natural conditions that arise spontaneously when an agricultural plant of a desirable variety is being produced. He denounced the Morganist flabbiness, lack of will, reliance upon elemental processes, and hopes for "chance favours" from nature. He counteracted these features with his own singleness of purpose and constant intelligent interference in nature's actions.

Michurin wrote:

"It is sufficient to introduce an expedient regime of training hybrid seedlings to consider the work as founded on quite scientific lines, and not on casual findings ... where the originator practically takes no part whatever, as he is compelled to use only what nature lets him have accidentally out of her ceaseless activity in changing the forms of living organisms."

MICHURIN RULES OF CHOICE (SELECTION)

Selection is, in Darwin's opinion, the key factor explaining man's success in obtaining useful plants and animals.

Michurin started his critical selection process not only by choosing hybrid seedlings, but also by selecting parental forms for the cross, by selecting healthy specimens during their first florescence, by selecting flowers located in the crown nearer to the "main vertical branches." Thus, Michurin's concern for the origination of a variety valuable for the national economy of the country began with the procurement of high-grade seeds and the directed training of the seedlings. In the course of several decades, Michurin elaborated profoundly scientific rules governing the selection of fruit plant seedlings.

Michurin made the *first selection* when the hybrid seedlings were still in the cotyledon state. He regarded large and thick cotyledon with short and thick stalks (hypocotyls), also tricotyledonous sprouts as the best signs of culture.

"The colouring in various shades of the lower and particularly of the upper part of the cotyledon always infallibly indicates the future colouring of the fruit...."

He made the *second selection* in the last vegetative period before the seedlings dropped their leaves, after a careful inspection made several times a day with the

sun lighting up different sides of the plants. This enabled him to observe every feature in the structure of each seedling. Michurin believed the best signs that a seedling is suited for cultivation to be: stouter build, larger leaf blades, thicker and shorter petioles and thicker shoot tips.

In Michurin's opinion, signs of undoubted suitability for cultivation are: thicker leaf blades; rounded and shallow dentation of their edges; fine and close venation of the bottom of the leaves; dark, lustreless and wrinkled faces; thick down (in apple trees), and well-developed, large-sized stipules. Michurin used to make a repeat selection after the leaves had dropped, considering as favourable signs: large, round buds at the tips of the shoots of the main stem; downy tips and faceted shoots; a close steep-spiral arrangement of the side buds, their large size and very prominent bud cushions.

These features, Michurin wrote, are a sign "... of a compact structure of the pulp of the future fruit; a sparse arrangement of buds in a wide spiral, however, presages a looser structure of pulp. Broadtipped buds, closely pressed to a straighter shoot is a good sign, whereas slender buds, deviating from a wavy shoot are signs of the wilding."

In stone-fruit plants (apricot, sour cherry, plum, sweet cherry) Michurin believed large round buds, arranged in groups of three or more, and large and numerous glandules on the petioles to be good signs. In the case of the pear and the apple, a darker colouring of the bark of the new shoots is mostly a sign of late winter-ripening of the future fruit, whereas a lighter colouring promises a summer-ripening variety. General low growth and the absence of small prickles are also good signs.

When selecting, Michurin considered it useful to compare the shape of the shoots and leaves of the hybrids with those of their parents, and to take one or another

relative similarity or deviation into account when appraising the merits of the seedling. Here Michurin warns that all these signs in one-year hybrid seedlings are, in most cases, only in a rudimentary, sometimes in a barely perceptible, state and gradually develop to their full dimensions only in the subsequent years of the seedling's growth.

It happens, however, that the presence of one negative sign in the seedling does not necessarily mean poor quality of the future fruit. For example, the Beurré d'Hardenpont pear tree bears excellent fruit, but the structure of its leaves is coarse and resembles those of wild pear trees. The Olivier de Serres pear, which bears fruit of good quality, has exceedingly feeble shoots and very small leaves.

Michurin usually made the *third selection* in the autumn of the third year of growth on the basis of the same signs, after which the hybrid seedlings would be transplanted to their permanent locations.

Michurin recommended that the *fourth selection* be made in accordance with the quality of the fruit which will speak for itself and will serve, as he put it, as a test of the plant breeder's work in originating the new variety.

Michurin recommended that the plant breeder should watch particularly for manifestations by the hybrid seedlings of any degree of immunity to damage by insects and to diseases at all stages of selection. "Such a quality in certain hybrids," he said, "must be carefully noted and cherished in general . . . such varieties will be of enormous value for the fruit-growing industry of the U.S.S.R."

He paid particular attention during selections under our severe climatic conditions to the seedlings' capacity to resist frost, and always warned plant breeders of the necessity for thoughtful and careful sorting of hybrid

seedlings before rejecting them on a presumption that they lack frost-resistance.

Often the end of summer is accompanied by a long period of high atmospheric pressure (between 760 and 770 millimetres), which forces some of the fruit trees (apple, sour cherry, mountain ash, and bird-cherry) to blossom a second time, this being attended by an intensive flow of sap. In such cases the seedlings are left to winter with immature mellow pulp and this leads to considerable damage by autumn frost. Such seedlings should not, however, be rejected, since in years favourable for their development they complete the period of vegetation in time, and winter very well.

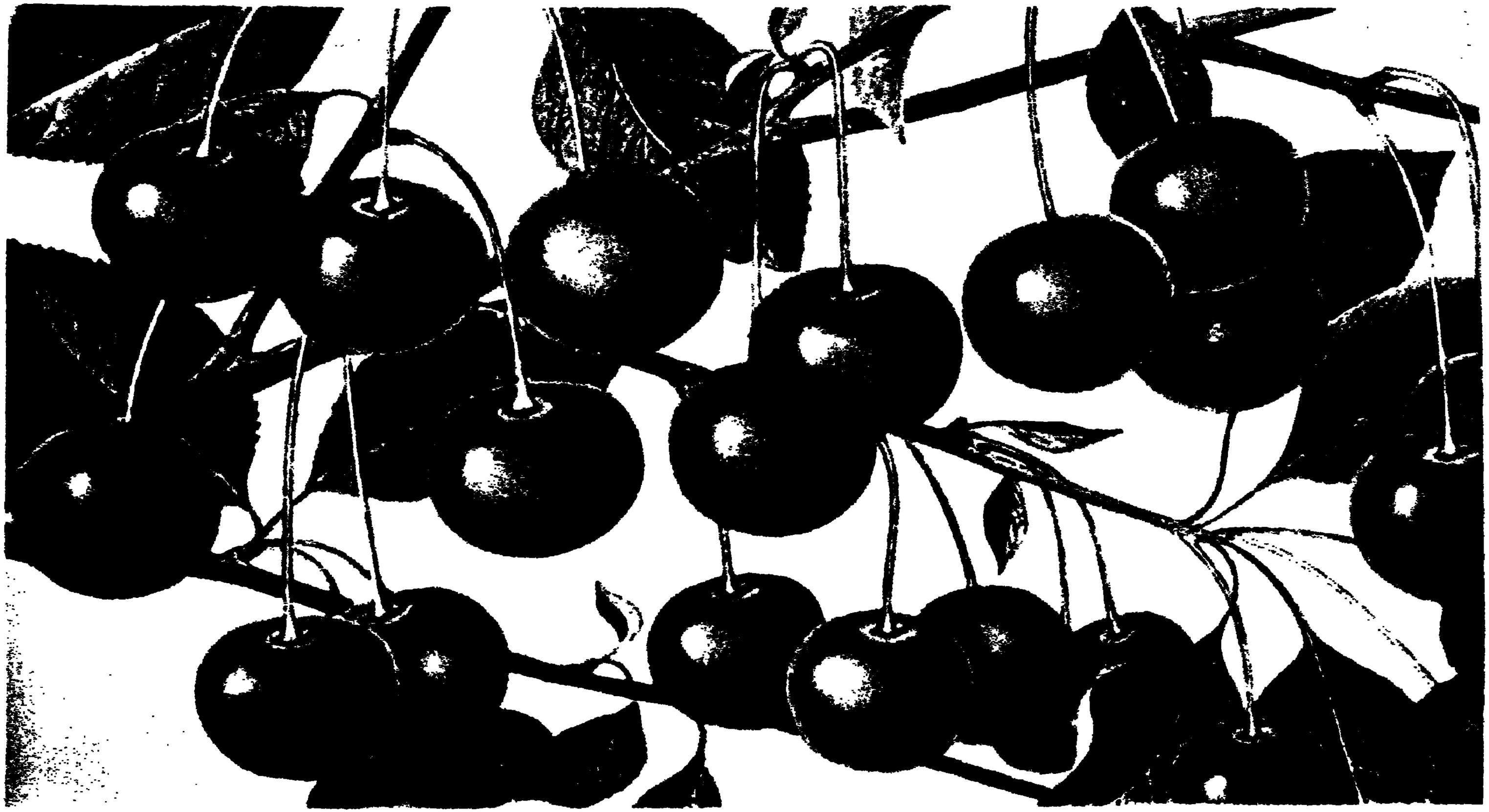
Michurin displayed particular care, patience and skill in selecting grape seedlings. He recommended that in selecting one- or two-year-old hybrid and simple grape seedlings (as well as all species of young plants in general) by their appearance, account should be taken of the fact that the constitution of all parts of the infant organism has an inherent tendency to deviate towards the form of the wild progenitors.

"This deviation," Michurin wrote, "is one of the manifestations of the so-called biogenetic law, according to which every organism in its embryonic and infant development repeats all the alterations of form through which its race had passed."

Michurin pointed out that industrial cultivation of grapes in the conditions of the central part of Russia is possible only when raising varieties with a short vegetative period, as this eliminates the danger of the young vine growth and the crop being damaged by late spring and early autumn frosts. This is the chief merit of the varieties in the conditions of northern vine-growing.

The other valuable properties of grape seedlings are, in Michurin's opinion, stouter growth of the seedling, length and thickness of the vine, size of the leaf blades,

Beurre Oktyabrya, the best sort of Michurin autumn pear



Michurin Plodorodnaya Cherry

Persikovaya plum

Reine Claude Reforma plum and its parents

winter-hardiness, and immunity to damage by insects and diseases.

After the grape seedlings began to bear fruit, Michurin made his selections on the basis of the yield, and of the flavour and appearance of the fruit.

Male specimens are encountered among grape seedlings of both hybrid and non-hybrid varieties. Michurin deemed it necessary to destroy such plants.

He attached great importance to the question of comprehensively studying new varieties of fruit and berry plants in various geographical conditions, this being dictated by the necessity to determine the areas of the future distribution of these plants.

In cases of wide distribution, a new variety of a fruit plant finds itself in various conditions of life, and, naturally, may lose some economic properties and characters, and acquire others.

Of great significance, too, is the influence of the stock, i.e., of the wilding to which the new variety is grafted.

The rich experience accumulated by fruit-growing points to the fact that the stock (the wilding) conditions the vigour of the fruitplant variety grafted to it; increases or reduces its ability to withstand frost or drought; accelerates or, conversely, retards the fruit bearing period; improves or deteriorates the qualities of the fruit—shape and colouring; and conditions the time of ripening, the capacity of the fruit to keep fresh, etc.

It is common knowledge that such a widely distributed variety of apple as the Antonovka fully manifests its best economic properties and qualities only in the conditions of the central non-black-earth zone and in the northern and middle parts of the central black-earth zone. South of these areas the Antonovka loses its valuable properties, becomes an autumn variety and no longer possesses its flavour.

"It becomes evident," Michurin wrote, "that as a result of bud variations we are not guaranteed, even when we use vegetative methods of propagating fruit trees, that trees of the same variety and growing in the same orchard would remain the same."

That is why not only new, but also old varieties of vegetable plants, that had been cultivated over centuries, possess different clones (forms). Many changes of the properties of the variety, brought about by external conditions, have been perpetuated by grafting, the eventual result being that the Anis tree has formed some 70 classes, the Antonovka—up to 40, while the Skrizhapel and others can likewise be divided into many types.

It was M. V. Rylov who wrote that "... a keen observer will note such trees and if he discerns any benefit in their deviation from the general type, he will try to propagate them by grafting, which represents for him a valuable means of firmly fixing the new character in the progeny."

Michurin always insistently demanded that only the most economically valuable clones within a variety should be propagated. For that reason he was particularly strict when choosing stocks.

In a letter to Professor N. I. Kichunov on August 12, 1920, Michurin wrote: "... an intelligently selected form, or, better still, a variety of stocks is enormously important in horticulture." Michurin cited the fact that the Moldavskaya Krasnaya pear (Malikovka) yielded normal-sized fruit when it was grafted to the crown of a forest pear tree, but when it was grafted to the crown of an own-rooted pear tree of a cultured variety the fruit it yielded was three times the normal size, the colouring brighter and the flavour superior. In the same letter he went on to say:

"It is time our horticulturists carefully looked into practical work and did not draw their conclusions on the

basis of theoretical considerations alone. There is hardly a sane person who would select a semi-cultured scraggy female pig of the type usually found in villages as the sow for a sucking pig of good breed, on the only grounds that it is hardy under conditions of continuous underfeeding and extreme dirt. And if such a crank can be pointed out, then his efforts would result in an animal that would not, by a long measure, possess the qualities inherent in a good breed."

He branded with all his intrinsic straightforwardness and in very strong terms those plant breeders who, Weismann-like, regarded the organism independently of environment and of the conditions of life. Michurin wrote:

"Only under the influence of complete mental shortsightedness and utter cretinism can one make the absurd assertion that, in order to breed new cultivated varieties of fruit trees, the seedlings should be reared in the same way as wildings for stock."

VEGETATIVE HYBRIDIZATION (THE MENTOR DOCTRINE)

Michurin's theory of vegetative (grafted) hybridization is the foundation of his general biological teaching on directing the development of vegetable organisms.

The Weismannist-Morganists, chained as they are to the theory that heredity is "unchangeable," that it is an "immortal substance," which they allege to be independent of the body, recognize the possibility of obtaining plant hybrids only by sexual union. They deny the possibility of obtaining vegetative hybrids since they do not recognize the influence of the conditions of life on the nature of the organism.

Michurin's teaching, on the other hand, maintains and explicitly proves that hybrids can be obtained not only by sexual union but by the vegetative method as well, i.e., by grafting varieties of agricultural plants of different

qualities to one another with the view to obtaining new varieties with desirable properties. Michurinist plant breeders carry out the vegetative hybridization of fruit trees, vegetables and melons, potatoes, cotton, and other plants.

Michurin's general biological teaching does not set sexual hybridization against vegetative hybridization but views them together.

According to Michurin, it is quite possible by means of the mentor method to alter at the plant breeder's will the properties and qualities of young hybrid seedlings of fruit, vegetable and technical plants, and potatoes in the direction most desirable to man.

Let us cite a few facts from the experience of Michurin and his followers.

1. We have before us a six- or seven-year-old own-rooted hybrid apple seedling which has not yet begun to bear fruit. Unless it is compelled to do so sooner, we shall have to wait another ten years as one of its parental forms reaches fruiting age only in its eighteenth or twentieth year of growth. "Well," Michurin said, "if we take three or four cuttings from a definitely high-yielding variety of fruiter and graft them onto the lower branches of this seedling's crown, not far from the trunk, our seedling will, under the influence of this mentor, bear fruit within the next two years. After this the mentor scions must be cut out, otherwise the mentor variety's influence may also affect the hybrid's fruit qualities and in the course of succeeding years this change may become permanently fixed in the new variety, which, of course, may not always be desirable."

If, on the contrary, the mentor variety possesses properties which are desirable for the fruit of the new hybrid, Michurin recommended letting the scions develop and bear fruit together with the hybrid during their first three or four bearing years.

2. In some cases Michurin used a mentor to eliminate sterility in interspecific hybrids. For example, the hybrid between a sour cherry and a bird-cherry (Cerapadus) blossomed but did not bear fruit. "But," Michurin said, "when it was transferred by grafting to sweet cherry stock with a view to obtaining better growth resulting from the influence of the stock, a process that I call mentor application, the flowers of the grafts set and bore well-developed fruit the next year."

3. "I have found the influence of the stock," Michurin said, "most strongly pronounced in the case of the new Krasa Severa variety of cherry, whose fruit on the maternal seed tree were a pure white, but when propagated by grafting on the seedlings of the common red sour cherry, the fruit on the grafted trees were of a pink colouring."

4. The appearance of hybrid apple seedlings, obtained by crossing a fifteen-year-old dwarf Kitaika (Chinese) apple tree (maternal plant) at its first florescence with the Crimean variety of the Kandil Sinap (paternal plant), began to deviate perceptibly in the direction of the father plant, i.e., the Kandil Sinap, which meant there was a danger of their freezing. Then, losing all hope of overcoming the resuscitating influence of the Sinap, Michurin decided to apply the influence of a mentor. He grafted a bud of one of the three seedlings of this hybrid to the crown of the same Kitaika (mother plant). The influence of that plant on its own offspring proved most beneficial. The grafts developed very well and did not suffer from frost at all.

5. In order to ascertain how much the stock influences the scion at the earliest possible stage of the latter's development, Michurin grafted in 1894 a bud of a young 600-gram Antonovka seedling to the crown of a three-year-old pear wilding and obtained in 1898 a vegetative apple-pear hybrid which he named the Reinette Bergamotte. When propagated by the vegetative method, the

Reinette Bergamotte staunchly keeps, as it has for over fifty years, the character acquired by it through vegetative hybridization, i.e., the pear-like shape of the fruit at the stem.

In 1935 Professor S. Isayev crossed the Reinette Bergamotte with different varieties of apple, including the Michurin variety of the Peppin Shafranny (Saffron). The hybrids obtained from this cross have, since 1944, borne fruit at the experimental station of the Michurin Scientific Research Fruit-Growing Institute. It is noteworthy that some of the hybrids inherited the characteristic shape of the Reinette Bergamotte fruit, which resemble pears. In other words, even when propagated by sexual union, they inherited the character acquired through vegetative hybridization. This character manifested itself most strongly in the hybrids of the Michurin apple variety obtained by crossing the Peppin Shafranny with the Reinette Bergamotte (mother plant). It is worth noting that in order to preclude any accidental errors in the experiment, S. Isayev used the Reinette Bergamotte as the father plant in these crossings.

The Reinette Bergamotte is cultivated in collective- and state-farm orchards in 22 regions in the U.S.S.R.

6. The fruit of the hybrid Bellefleur-Kitaika apple tree, obtained by Michurin by crossing the Bellefleur Yellow (maternal plant) with the Kitaika (paternal plant) manifested the characteristics of the Kitaika in the first year of bearing. They were of medium size, summer-ripening and incapable of keeping long, features that did not enter Michurin's calculations. In order to eliminate these defects, in 1915 he grafted cuttings of the mentor, i.e., of the Bellefleur Yellow (the maternal plant), to the crown of a young hybrid. The fruits of the Bellefleur-Kitaika grew in size under the influence of the mentor. Not stopping at that, Michurin, in the following year, grafted to the crown of the hybrid six more cuttings of different apple

varieties, including the Napoleon apple; this resulted in still larger fruit and in further delaying their ripening. Finally, in 1919, Michurin grafted cuttings of the Bellefleur-Kitaika to the crown of a twenty-year-old 600-gram Antonovka. It was under the influence of this stock-mentor that the Bellefleur-Kitaika took final shape as a variety in 1921-1926, giving a generous annual yield, the fruit weighing up to 340 grams, having a fine flavour and a still longer storage capacity, i.e., till January or February.

Thus, the Bellefleur-Kitaika variety has been created with the help of the mentor method.

7. "An adult tree of the Bergamotte Novik hybrid pear," Michurin wrote, "set fruit very scantily during its first three fruiting years; the fruit ripened early (at the end of July) and was similar to the Bergamotte in shape. After some cuttings of the Malikovka pear had been grafted as mentor onto the crown of this tree, it fruited abundantly the second year, but two weeks later than before, and the shape of the fruit changed beyond recognition.

"In addition, the fruit on the mentor scions were twice the usual Malikovka size."

Michurin applied the mentor method not only to develop or fix in a hybrid some useful character like accelerated fruiting, but also to solve many other more important problems such as bringing about higher yields, larger fruit, more pleasing colouring, longer storage capacity, greater sugar content in the fruit and cold-resistance.

The mentor method puts an end to casualness in plant breeding and transforms the plant breeder from a treasure-hunter awaiting favours from nature into a creator capable of purposefully directing the heredity variability of vegetable organisms.

Michurin spoke penetratingly about the mighty creative role of the mentor method, scientifically foretelling that by carefully elaborating this method: "... we shall

at last have made a big step towards achieving the long-desired control over the process, without which the results of our work have for the greater part been dependent on various accidental outside factors. . . ."

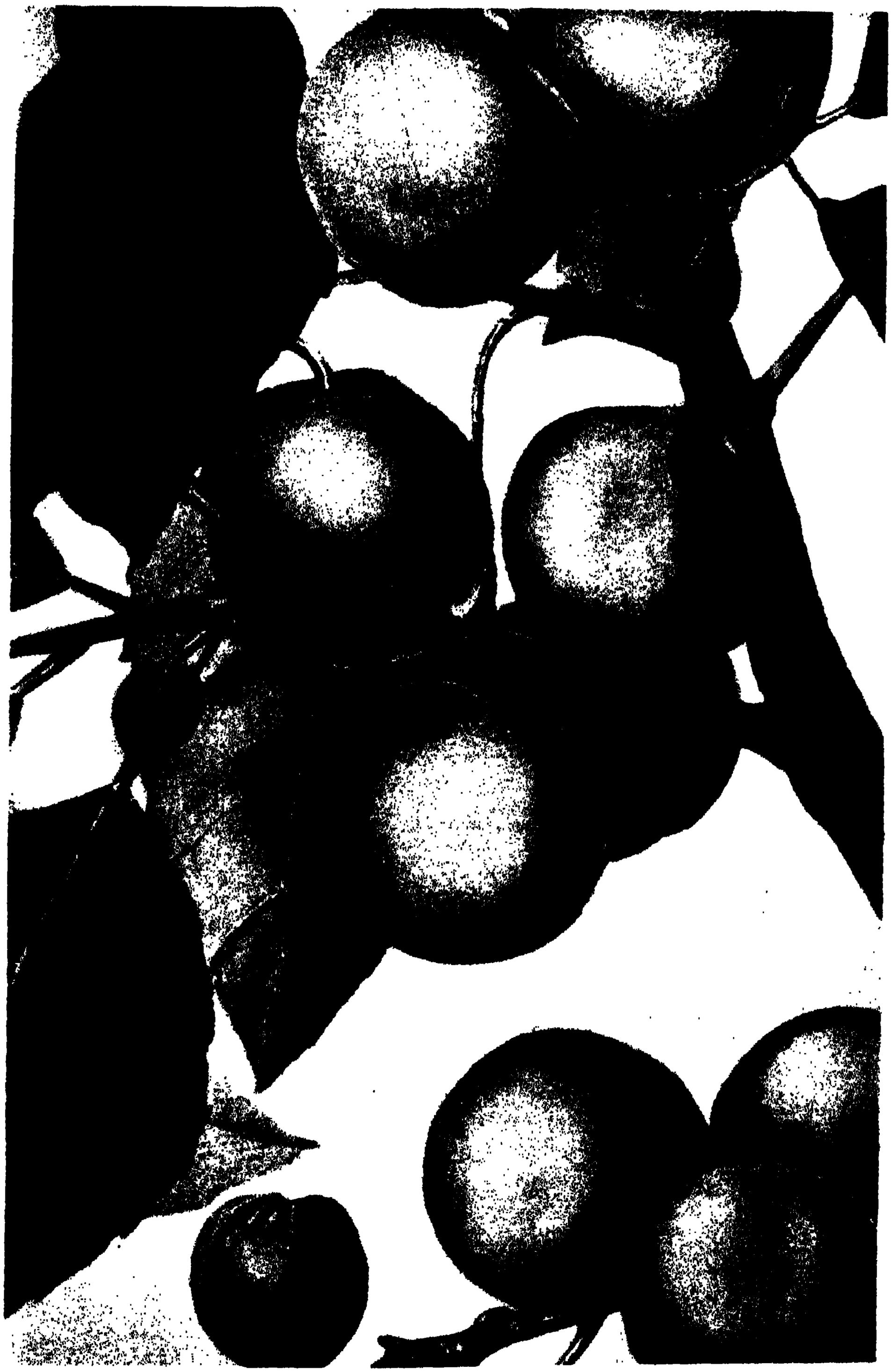
Elsewhere he said: "Such deviation of hybrid fruiters in the desired direction, which I qualified as the application of 'mentors' and the efficacy of which I more or less tested on other plant forms, is an extremely valuable tool in the hands of man by means of which he can govern the structure of plant organisms—something that was formerly not even imagined . . . And in the nearest future by such means man will most probably create altogether new types of plants, such as will more completely meet his requirements and be better adapted to the inevitable changes in climatic conditions."

Numerous facts from the experience of scientists and practical workers irrefutably prove these theses advanced by Michurin.

It is known that in the conditions of the central zone a Jerusalem artichoke, when on its own roots, does not blossom and, consequently, does not produce seeds; it propagates only by the vegetative method. However, when in 1925 Michurin's assistant, I. S. Gorshkov, grafted a Jerusalem artichoke to a sunflower, both the stock (sunflower) and the scion (Jerusalem artichoke) blossomed simultaneously in the conditions of the town of Michurinsk.

Other experiments by Gorshkov, which he conducted to investigate the influence of the stock on the scion and vice versa, showed that the forest apple tree (stock), when grafted with a Peppin Shafranny (a Michurin variety of apple), forms a round-shaped light-coloured root system, and when grafted with a Reinette Bergamotte apple tree, it produces elongated dark brown roots that imbed deep into the soil.

In his book *Vegetative Hybridization*, I. E. Glushchen-



Michurin Luchshy apricot

Productivnaya raspberry

ko, Doctor of Biology, cites a number of facts to illustrate how the heredity of various species of plants change radically under the influence of mentors, obtained by himself and other scientists, and by Michurinist practical experimenters.

Let us cite a few instances from Glushchenko's works. The wild potato does not form tubers under the climatic conditions and normal day prevailing in Moscow. "When grafted with seedlings of the cultured Epron variety it forms tubers depending on the condition of the scion. Tubers are always formed if the scion possesses a well-developed capacity for assimilation, and, conversely, no tubers are formed if the scion is poorly developed. When reverse graftings are made (Epron seedlings taken as stock, and the wild potato as scion) the opposite law holds: if the scion is strongly developed the cultured seedlings do not produce tubers, but when the scion is poorly developed, the formation of tubers does take place." Glushchenko pointed out that when the Golden Queen tomato was grafted to the Ficarazzi, and the Golden tomato to the Mexican tomato 353, the seed progeny produced hybrid forms possessing the characters of both grafted components (yellow and red fruits on one and the same cluster, etc.), and the high yield of these forms was noted.

Glushchenko also described his vegetative hybrids of tomatoes that yield fruit of an altered colour, and the results of his investigation up to the fourth seed generation.

A. S. Filippov, Candidate of Biology and senior scientific worker at the All-Union Potato Institute (near Moscow), raised the 126/2 vegetative potato hybrid, which is unique for its frost-resisting qualities, immunity to fungus diseases and cancer, and high starch content.

The works of A. M. Sokolov, Candidate of Agricultural Sciences and entomologist at the Michurin Central

Genetics Laboratory, stress the mentor's great role in rendering fruit plants immune to such a deadly pest as the Aphis mali.

How is the process of the formation of a vegetative hybrid to be explained?

Let us begin with an explanation of the vital process of the cells, both vegetative and sexual. In his article *Mentor—A Powerful Means of Selection*, Academician Lysenko lucidly explained these processes. He said that every vegetable cell, developing by assimilation and dissimilation, in other words, by absorbing nutrient substances and excreting disintegrated compounds, and by going through a number of transformations (intracellular processes connected with metabolism), splits into two.

The question arises: from where and how does the vegetable cell get the nutrient substances?

A living vegetable organism as a whole builds itself out of external inorganic nature by assimilating the nutritive substances provided by environment.

What happens then in the vital processes of the sexual cells?

Academician Lysenko said that "... assimilation also takes place when two sex cells fuse, although this differs fundamentally from the first case. It may be said that the egg cell assimilates the nucleus of the spermatozoid, but the opposite may also be said: the nucleus of the spermatozoid assimilates the egg cell. More exactly, when two sex cells fuse, they mutually assimilate each other. As a result, neither of the cells remains; a new cell is formed—a zygote, which differs qualitatively from both the egg cell and the spermatozoid."[1]

It is namely in this that one of the distinguishing features of the fertilization process lies, i.e., the formation

[1] T. D. Lysenko, *Agrobiology*, Eng. ed., Moscow 1954, p. 236.

of a zygote (the vital foundation of the new organism) through the vital process of the plant cell.

It is clear from this that not only vegetable and sexual cells, but the entire plant organism as a whole as well as its individual organs, by virtue of hereditary properties, possess an elective capacity for the conditions of environment, and above all, for nutrient substances. The elective capacity is an indispensable biological function of organisms without which their interaction with environment is inconceivable. Lysenko said, "*The elective capacity possessed by organisms, organs and cells is the result of the historical adaption of preceding generations to environmental conditions.*"[1]

Hence, a zygote of an apple tree, for example, formed by the fusion of two sexual cells of the parental plants requires the conditions of development of both parents. This is how matters stand as regards the process of fertilization.

When vegetative hybridization takes place, i.e., when one plant is grafted to another, fertilization does not take place, since neither the stock nor the scion can exchange chromosomes of the nuclei or the protoplasm. Nevertheless, some serious changes, even radical changes of heredity are bound to take place in cases when one of the pair is a young hybrid with a destabilized heredity.

Michurin said that "... young fruit-plant hybrids are particularly plastic and susceptible to change, and adapt themselves with remarkable ease to the various external conditions of their environment and to symbiosis with other species when grafted."

In a note to this thesis Michurin added: "They also 'adapt' and 'accustom' themselves to the natural method of propagation by grafting, and, being more pliable

[1] *Ibid.*, p. 236.

in all respects, endure the actual process of union more easily, assimilating saps of alien origin and composition."

It was Darwin who wrote about the possibility of obtaining vegetative hybrids by means of a mutual exchange of nutrient substances by the plant cells of two different components. The elements utilized to give rise to a new substance are not necessarily always formed in male or female reproductive organs; they are present in the cellular tissue, and they are in such a state that they can fuse without the sexual organs taking part, thus originating a bud which assumes the characters of both parental forms.

That inheritance of acquired characters of vegetative hybrids follows certain law-governed processes was made perfectly clear by Michurin when he produced his varieties of apple (Reinette Bergamotte, Bellefleur-Kitaika, Kandil-Kitaika), pear (Bergamotte Novik), sour cherry (Krasa Severa), and many other strains of other breeds.

The point to be clarified is the physiological process of the formation of vegetative hybrids. Academician Lysenko furnishes here a clear answer.

"The different plastic substances in the leaves, stems, and tubers of the potato, of the Epicure variety, let us say, are usually such that when the stolons (the underground shoots on which the tubers develop) of Epicure feed on them, they produce Epicure tubers.

"What will happen if we learn how to feed the cells of one variety of plant with (i.e., compel them suitably to assimilate) the ready-made plastic substances of another variety, i.e., merge, as it were, two breeds of plants into one, as happens during the fusion of sex cells? Logically, one would expect the formation of new cells of a new breed—in other words, the formation of a vegetative hybrid possessing in some degree the properties of both the first and the second variety. It seems to me that

these hybrids should not differ fundamentally from hybrids obtained sexually."[1]

Consequently, plastic substances formed by the scion and the stock fully possess the properties of their breed, i.e., heredity. Moreover, when there is an inosculation, a fusion of somatic, i.e., vegetative cells, tissues of the scion and the stock, there takes place a mutual, or as Lysenko put it, a reciprocal assimilation of plastic substances by both components. And since, as we know, plastic substances carry the properties of the breed, the properties of heredity, it is this factor that works to create hereditary hybrids.

"...*Vegetative hybrids*," Lysenko said, "*do not differ in principle from sexually-propagated hybrids. Any character may be transmitted from one breed to another by grafting as well as sexual propagation.* The behaviour of vegetative hybrids in succeeding generations is likewise analogous to the behaviour of sexually propagated hybrids. When sowing seeds of vegetative hybrids, for instance, of tomatoes (without further grafting), the hybrid properties of the plants of the preceding generation appear also in the plants of the subsequent generation."[2]

Michurin justly criticized Vöchting, Molisch, Kerner, and other foreign biologists for their doubting and for denying the possibility of obtaining vegetative hybrids. He proved this possibility by facts. "As a matter of fact," he wrote, "this is an indefeasible law, not only fully analogous to the phenomena observable in the case of the sexual union of various plant forms, but in some cases even more so. (I will go even further: Here we are directly confronted with one of the details of the universal struggle of organic forms for their existence.)"

In the field of vegetative hybridization there is yet

[1] *Ibid.*, p. 237.
[2] *Ibid.*, p. 419.

another law-governed process which should be borne in mind and to which Michurin always paid great attention. The law consists in the proper selection of components. While Michurin did not cross each and every plant by sexual hybridization, but elaborated a harmonious scientific system of selecting the initial progenitor forms, he likewise required a purposeful selection of components in the field of vegetative hybridization. In his *Synopsis* he expounded a whole system of selecting components with due regard to the time required for a complete symbiosis between them, of their individual properties, reciprocal action of their leaf systems, the influence of the roots of the stock, etc., and demanded that each of the components should be approached individually.

As Michurin put it: "Each plant in a union adapts itself only to its own pair, and not to the whole species."

Vegetative hybrids among fruit plants, vegetables and melons, potatoes, tea, citrus, and other plants are of two-fold significance—economic and general theoretical.

The economic importance of vegetative hybridization consists in higher cold resistance and yields, early ripening, improved quality of the fruit, greater health and immunity of the plants to diseases and damage caused by pests.

The discovery of the laws of heredity, altered by grafting genetic characters (properties) of agricultural plants, constitutes the theoretical significance of vegetative hybridization, which manifests the triumph and vitality of Michurin's materialist teaching on the unity and equivalence of all the factors of living nature that promote development.

The denial of vegetative hybridization by the Weismannist-Morganists, demonstrates the total invalidity of their idealist, metaphysical theory of the existence of a "special, immortal hereditary substance," independent of the organism and environment.

Developing further Michurin's teaching on vegetative hybridization, Soviet biologists uphold a materialist conception of the development of nature.

"The whole of nature accessible to us," Engels said, "forms a system, an interconnected totality of bodies, and by bodies we understand here all material existence extending from stars to atoms, indeed right to ether particles, in so far as one grants the existence of the last named. In the fact that these bodies are interconnected is already included that they react on one another, and it is precisely this mutual reaction that constitutes motion."[1]

The following conclusions may be drawn from the above brief exposition of the foundations of Michurin's general biological teaching:

1. Michurin's teaching, which is a dialectical materialist and progressive teaching, rejects and exposes the fallacious vicious Weismannist (Mendelist-Morganist) idea of the impossibility of directing alterations in the nature of organisms with the help of man-controlled conditions of the life of plants, animals and microorganisms.

2. Michurin's teaching is the summit of biological knowledge. It fully meets the interests of collective- and state-farm production and helps to produce new high-yielding plants and new highly productive breeds of domestic animals.

3. Having arisen out of the most urgent needs of agricultural practical work, Michurin's general biological teaching is the pride of all Soviet science. It opens vast perspectives for the creative activities of Soviet scientists and practical workers.

"... Now, when man, in the course of his evolution, has reached a higher stage of his development, he can no longer be dependent on chance, he is not satisfied

[1] F. Engels, *Dialectics of Nature*, Russ. ed., Gospolitizdat, Moscow 1950, p. 45.

with using the doles of Nature, which is blind to his needs. The time has come when man is able not only to produce the lifeless mechanisms of different machines, but also to create living organisms of new species of plants, and in the future, probably, also be able to create new species of animals more useful for his existence."[1]

[1] I. V. Michurin, Vol. I, pp. 434-35, Selkhozgiz, 1948.

Izobilnaya blackberry

Malengra grape seedling raised by Ivan Michurin

3. MICHURIN BIOLOGICAL SCIENCE AT THE SERVICE OF COMMUNISM

Karl Marx, the great teacher of the proletariat, said that theory becomes a material force as soon as it has gripped the masses.

Michurin's theory that the conditions of life influence the formation of plants and animals, that organisms inherit new properties and qualities acquired by them during their lives, that it is possible to direct this process in a planned way by altering environment, has become a colossal material force.

The movement of collective-farm experimenters to master Michurin's teaching which started long before his death, has now assumed an unprecedented, truly mass scope and has become a real material force of Soviet socialist society. Breaking with servile submission to the elemental forces of nature, Michurin's pupils and followers today are making these very forces serve toiling humanity.

Scores of institutes, hundreds of zonal experimental stations and centres, thousands of collective-farm laboratories in the North, the Urals, the Far East and Siberia are using Michurin's method to raise new winter-hardy high-yielding varieties of grain, vegetables, technical, and fruit plants.

The Michurin Central Genetics Laboratory, founded and directed at the time by Michurin, has grown from

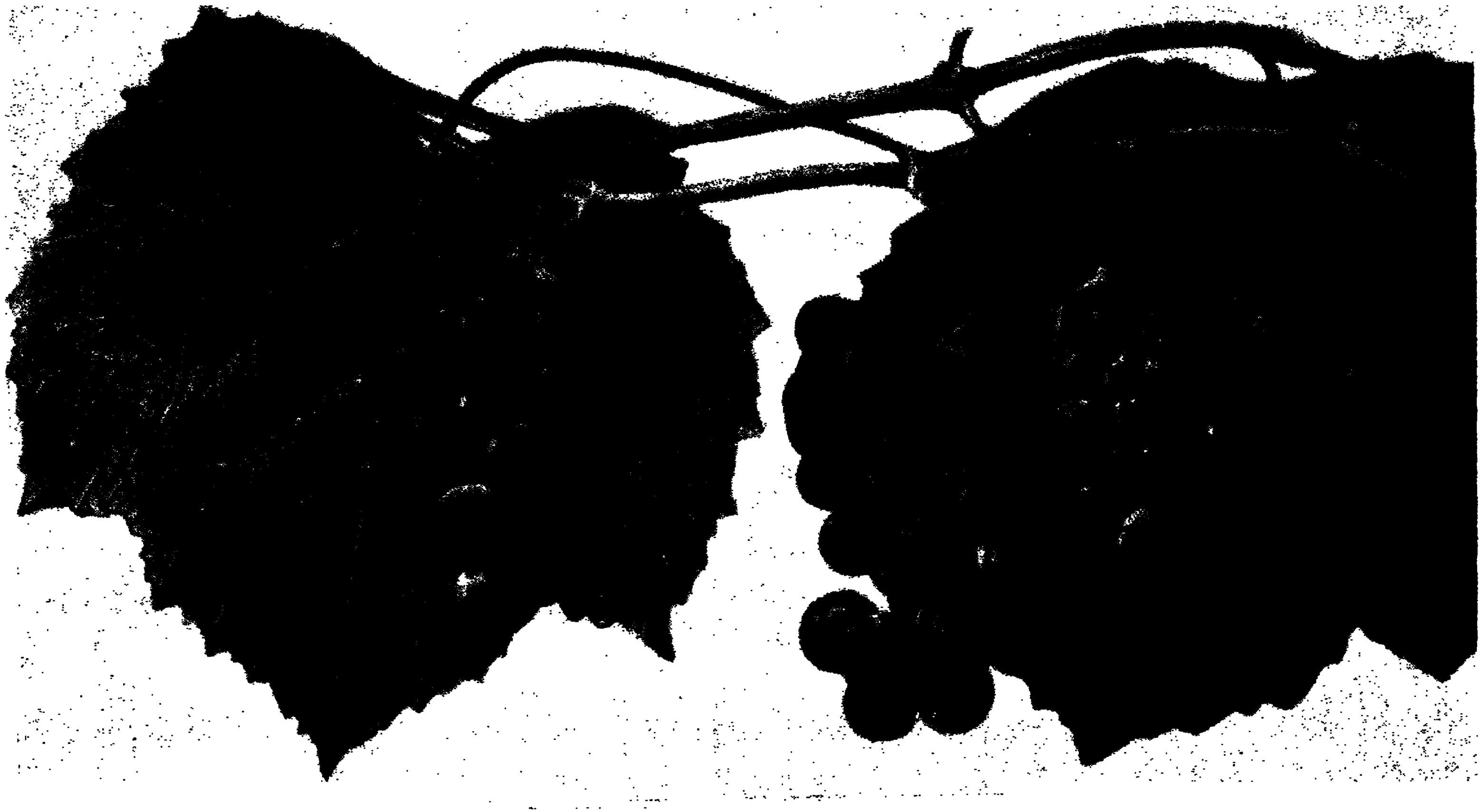
the tiny nursery it was in the pre-revolutionary period into a major scientific-research institution.

The once cheerless sun-scorched wasteland and dry barren fields around Michurinsk have given place to scientific and educational establishments, laboratories, hothouses, greenhouses, nurseries, fruit storehouses, and power stations of the Central Genetics Laboratory, the Scientific Research Institute of Fruit Growing, the Fruit and Vegetable Technical School, and the Michurin state-farm orchard, which comprise the centre of the country's scientific and industrial fruit growing. For miles and miles around these establishments the land is occupied by new nurseries, experimental plots, collection, seed-testing, and industrial orchards, and together they form a living laboratory of the creative idea of Michurin, the great remaker of nature. Everywhere there are apple, pear, sour cherry, and plum orchards, vineyards, plantations of currants, gooseberries, raspberries, strawberries, and other plants. One can encounter there sweet cherry, apricot, filberts, quince, and other plants which were never cultivated in that locality.

The orchards in the suburbs of Michurinsk occupy an area of three thousand five hundred hectares, whereas twenty years ago there were only small private orchards containing a score or so of poor apple and pear trees of the old varieties.

At present these orchards, although they are young and have just started bearing, are yielding thousands of tons of delicious fruit and berries. The yield will increase proportionally with the age of the trees. At the age of 12-15 years most Michurin varieties of apple and pear trees bear an annual yield of 25 to 30 tons per hectare, while at the age of 25 the yield reaches 50-70 tons per hectare.

The northern varieties of grapes which Michurin and his followers have raised, are spreading far and wide.



Michurin Russian Concord grapes
diminished

Grape, which only recently was considered an exotic fruit in the Tambov region, is now a local culture and is successfully moving farther north—to the Ryazan, Tula, Moscow, Kalinin, Velikiye Luki and even to the Novgorod and Leningrad regions. The new northern varieties of sweet cherry, apricot, filberts, and other plants raised by Michurin and his pupils are being introduced into culture on an increasing scale with growing boldness.

A large collection of different varieties of apples, pears, sour cherries, and plums bred by Michurin and his followers, as well as the best strains of popular selection, are being cultivated in the seed-testing orchards of the Central Genetics Laboratory and the Scientific Research Institute. This collection includes more than 2,500 varieties and is the most important source of supply for the orchards of the collective and state farms of the whole central zone, a considerable part of the north-eastern zone, and the mountainous regions of the U.S.S.R.

The most economically valuable apple trees, noted for their frost-resisting qualities and abundant yields of high-quality fruit that is in no way inferior to those of southern strains, include: Bellefleur-Kitaika, Peppin Shafranny, Peppin-Kitaika, Coulon-Kitaika, Shafran-Kitaika, Slavyanka, Calville Anisovy; Beurré Zimnaya pear; Reine Claude Reforma and Reine Claude Kolkhozny plums; Krasa Severa, Plodorodnaya and Shirpotreb sour cherries.

To meet the enormous demand for the Michurin varieties, the Central Genetics Laboratory alone raised in its nurseries in 1924-1950 and distributed 750,000 seedlings of apple, pear, sour cherry, plum, and sweet cherry trees, 572,100 cuttings of grapes and 310,364 shrubs of small-fruit plants; the recipients were scores of thousands of collective- and state-farm orchards, experimental stations and Michurinist experimenters in 74 Regions, Territo-

ries, Union and Autonomous Republics. In addition, collective- and state-farm nurseries received within the same period 1,129,967 apple, pear, sour cherry, plum, and sweet cherry cuttings for the grafting of 5,649,835 wildings. The number of Michurin variety seedlings grown by the Michurin Scientific Research Institute of Fruit Growing, state-farm orchards, and collective- and state-farm nurseries is increasing annually.

Michurin's behest to Soviet plant breeders was that they should unceasingly raise new varieties of agricultural plants with a higher qualitative value than that of the existing varieties. In compliance with this noble patriotic behest, the Central Genetics Laboratory, whose experimental plots and orchards spread over an area of 500 hectares, produced in the 19 years after Michurin's death more than 120 new economically valuable varieties of apples, pears, sweet-tasting sour cherries, sweet cherries, plums, filberts, early-ripening and cold-resisting varieties of grapes, melons, and tomatoes distinguished for their short vegetative period.

From 40,000 to 50,000 people from all the parts of the U.S.S.R. visit Michurinsk annually. Students of agricultural and pedagogical institutes and biological departments of universities go there to write their graduation theses. Cinema workers produce new scientific films that graphically reveal to the people Michurin's methods of raising new varieties of agricultural plants. Artists go to Michurinsk to paint pictures of blossoming orchards yielding fruit of the Michurin varieties. Writers and poets glorify in prose and verse the work of this great plant breeder.

Scientists go to Michurinsk to share and sum up their experience and to map out new tasks in the field of agricultural plant selection and genetics. Young Naturalists visit the Michurin scientific-research fruit-growing establishments to learn the foundations of Michurinist science.

* * *

Relying on his transformatory teaching, Michurin perseveringly propagated for fifty years the great idea that it is possible to extend fruit-growing to the north, the Urals and Siberia, where for many centuries this problem was considered insoluble. Michurin's dream is now being realized. Today Michurin's followers in every territory and region of the vast Soviet Union, use his method to produce varieties of grain, industrial, fruit and berry plants suitable to local climatic and soil conditions.

The Michurin Scientific Research Institute of Fruit Growing and its zonal experimental stations have already raised 819 choice seedlings and delivered 225 new promising forms of various fruit plants to state varietal test institutions. In addition, they introduced more than 100 new valuable strains of apple, pear, sour cherry, and plum as a standard assortment in the central and northern zones, in the Volga country, the Urals, the south-eastern zone, Western, Central, and Eastern Siberia, and new varieties of apricot, sweet cherry and grapes as a standard assortment in the southern zone.

Before the Great October Socialist Revolution fruit-gardening was non-existent in Siberia or in the Urals. In 1920, throughout the vast expanses of the Urals, Siberia, and the Far East, only 300 hectares of land were planted under orchards. These belonged to pioneers in horticulture, and were so small that some had no more than five or ten Siberian Reinette apple trees, that bore forest-nut-sized fruit, and a few local wild currants, raspberries, gooseberries and bitter-tasting bird-cherries.

Ardent patriots, like D. I. Mendeleyev, the great Russian scientist, who were Michurin's countrymen and contemporaries, focussed their genius to the north, the Urals and Siberia, and worked to develop these boundless regions of our country. While Mendeleyev was indicating

the proper way of utilizing the mineral resources of these regions, Michurin was teaching the pioneers of fruit-gardening how to combat the severe climate of those localities. In an address *To Fruit Growers of the Urals and Siberia,* Michurin wrote: "Seedlings . . . bred locally from seeds obtained by crossing the local wild species with western varieties are always completely dependable material, if for no other reason than that such seedlings *from the earliest stage of their development build up the texture of their organism under the constant influence of the external local climatic conditions* (my italics—*A. B.*). That is why they will not have to fear any adversities in the Urals area or far-off Siberia."

But this brilliant scientific thesis could be realized only in the conditions of the collective-farm system, and only as a result of the successful fulfilment of the five-year plans by the Soviet people. Michurin did not passively observe the profound revolution in the countryside that was carried out under the leadership of the Communist Party. He shared actively in the collective-farm movement and it was due to this that he was able to utter immortal words of profound faith in the transformatory force of the collective-farm system.

"In the collective farmer," Michurin wrote in 1935, "the history of agriculture of all times and peoples has a new agriculturist who has taken the field against the elements with wonderful technical armaments and is influencing nature as a transformer."

Less than twenty years have passed since these lines were written, and now in the Urals and Siberia, where fruit-growing was unknown, there are tens of thousands of hectares of blossoming collective-farm orchards.

Scientists, enthusiasts of horticulture in the Urals and Siberia, many outstanding practical workers, and Michurinist experimenters have victoriously applied

Michurin's teaching in the struggle with the severe climate of the Urals and Siberia.

Michurinist experimenters among the workers of the Urals Machine-Building Plant displayed remarkable initiative in setting up collective fruit-gardening. At the Urals Machine-Building Plant there are already 16 collective fruit and berry orchards, covering a total area of 65 hectares and serviced by a wide network of irrigation. Upwards of one thousand workers are engaged in collective horticulture. Every year they gather bumper crops of berries—raspberries, currants, gooseberries, and wild strawberries. They are applying Michurin's methods of selecting fruit and berry plants, and soon they will have their own local varieties of apple, pear, sour cherry, and plum.

The fame of the collective orchards of the Urals Machine-Building Plant has spread throughout the Urals and Siberia, and now there are collective orchards in Novosibirsk and other towns.

The extent of the present work in the field of Michurin selection and horticulture can be seen from the fact that by the end of 1949 in the Altai Territory alone 1,132 collective farms had orchards; these were not amateur orchards but orchards of a market type that brought in no mean income to the collective farmers. The fruit and berry orchards of some of these collective farms occupy an area of 30 to 40 hectares.

Here are the results of the development of fruit-gardening in some of the collective farms in the Altai Territory.

The Molotov Collective Farm in the Shipunov district, a farm well-known in the U.S.S.R. headed by F. M. Grinko, an outstanding Siberian Michurinist horticulturist, had an income of 421,000 rubles in 1946 from gardening; in 1936-1946 the income from the collective-farm orchard and nursery amounted to 3,100,000 rubles.

The Banner of Labour Collective Farm, Romanov district, where I. V. Ukrainsky, an enthusiast of Michurin methods, leads the brigade of fruit-gardeners, in 1938-1948 netted an income of 1,458,000 rubles from gardening.

Before Michurin's time the northernmost boundary of apple cultivation passed through the cities of Vologda, Kirov (formerly Vyatka), and Ufa. Today the Michurin varieties of apple, as well as new Urals-Siberian strains produced by local plant breeders in accordance with Michurin's methods, are grown in the vast spaces of Siberia.

A remarkable element in the development of horticulture in the Urals and Siberia is its steady and systematic progress.

Before 1929 only ten hectares were planted to orchards in the Krasnoyarsk Territory that stretches from the Mongolian People's Republic to the shores of the Arctic Ocean. At present orchards occupy an area of more than 3,000 hectares, while in the Minusinsk district every collective farm has an orchard.

In the Sverdlovsk, Chelyabinsk, Novosibirsk, and Omsk regions fruit orchards occupy areas ranging from 2,000 to 3,000 hectares.

Following the path blazed by Michurin, distinguished plant breeders in the Urals and Siberia—scientists and practical workers—have, in the last 20 years, produced 225 local varieties of apples, pears, sour cherries, plums, currants, gooseberries, Hippophaë rhamnoides, raspberries, and wild strawberries, which opens still greater prospects for the further development of horticulture in the Urals and Siberia.

Mikhail Afanasyevich Lisavenko, Doctor of Agricultural Sciences and Stalin Prize Winner, who is a pioneer in Michurinist selection in Altai and director of a zonal experimental station there, has raised a large collection of hybrid fruit and berry plants. This collection is the

principal basis for the further progress of fruit-growing in that immense territory.

Plant breeders at the Krasnoyarsk experimental station, led by N. N. Tikhonov and N. M. Simakov, played an important role in the promotion of fruit growing in the Krasnoyarsk Territory. In the conditions of the severe climate of Eastern Siberia the station bred eighteen varieties of apple, seven varieties of plum and twelve varieties of currant for local use. During the twenty years of its existence the station distributed about 3,000,000 seedlings and 500,000 cuttings among collective and state farms in the territory.

To investigate the potentialities of developing fruit growing in the Far North, the personnel of the Krasnoyarsk experimental station helped the pioneers of northern horticulture to lay out fruit orchards in Eniseisk, Igarka, Bodaibo, Yakutsk, Turukhansk, Narym, and in Kamchatka.

P. A. Zhavoronkov, scientific worker at the Chelyabinsk experimental station, raised large-fruit-bearing apple trees for cultivation in the Eastern Urals. These are the Reinette Uralsky (Reinette of the Urals), Uralskoye Zoloto (Gold of the Urals), Seyanets Arkad Zholty (Seedling of Arkad Yellow) and others.

D. A. Andreichenko, a plant breeder at the Novosibirsk experimental station, originated a number of valuable strains of currant and gooseberry.

A. D. Kizyurin, Professor at Omsk University, scientifically substantiated and introduced on a large scale a creeper variety of apple tree in the orchards of the Urals and Siberia.

V. I. Gvozdev, scientific worker at the Bokhchary experimental station, produced a number of varieties of apple for Narym. The special scientific method of cultivating creeper apple trees that he worked out makes it

possible to obtain up to forty-five tons of fruit per hectare in the severe climate of Narym.

Fruit trees never grew on Sakhalin Island, but D. Tarasyuk, a Michurinist agronomist and an enthusiastic fruit grower, laid out a large orchard there. He is successfully experimenting on a number of Michurin and Siberian varieties of apple, pear, plum, and various small-fruit plants, thereby demonstrating the triumph of Michurinist agrobiology.

The Michurinists of the Issyk-Kul region (Dzhety-Oguz), harvested in 1950 in the Tien-Shan Mountains, at an altitude of 2,000 metres above sea level, the first crop of apples and originated a mountain, cold-resistant variety of apricot.

Particularly gladdening is the fact that besides Michurinist scientists, and in close contact with them, Michurinist practical workers and collective-farm gardeners are creatively exerting every effort to raise new high-grade varieties of agricultural plants and to promote horticulture and viticulture in all the territories and regions of the U.S.S.R.

A. V. Roshchupkin, leader of the gardeners' brigade at the Michurin Collective Farm, Izberdeyev district, Tambov region, laid out in 1936 an orchard of 21 hectares and, in Michurin's honour, planted it exclusively with seeds of the Michurin varieties. By scrupulously observing Michurin's technique in agriculture, he obtained excellent harvests. In 1950, he took in more than 80 tons of apples from a young orchard of 12 hectares. This brought the collective farm an income of 631,000 rubles.

B. M. Alopeus, a Michurinist experimenter in Tambov, raised valuable varieties of apple: Boris, Zolotoy Shar, Bespodobnoye, Fioletovoye, and Evrika which, after testing at the Michurin Central Genetics Laboratory, will be propagated and destributed in the orchards of collective and state farms of the region.

To the surprise of the local inhabitants, N. S. Voitenkovich, a Michurinist experimenter in Chkalov, planted and cultivated in the dry steppe a collective-farm orchard of three hectares. He is experimenting on more than 100 varieties of apple, eight varieties of pear, six varieties of plum, 25 varieties of berries and 12 varieties of grapes. This collection is a very valuable propagation centre for the promotion of horticulture in the Chkalov region.

By applying hybridization N. S. Voitenkovich is originating new local strains of fruit plants.

The enthusiasts of northern viticulture have not only mastered the cultivation of grapes in the conditions of the central belt of the U.S.S.R., but have extended it further to the north by raising local winter-hardy varieties.

V. M. Lavrentyev, a Michurinist experimenter in Kaluga, cultivated a new strain of grapes called Nata, which is noted for its short vegetative period and the high quality of its fruit.

V. F. Kopylov, a Michurinist experimenter at the Dobrovolets Collective Farm, Zadonsk district, Oryol region, originated two winter-hardy varieties of grapes, the Slitny and the Silvaner, which yield splendid fruit.

S. P. Polyansky, a veteran Michurinist experimenter, in cultivating the Don, Astrakhan, and southern varieties of grapes attained brilliant results in obtaining high yields. His vineyard in Kuibyshev numbers 250 shrubs and yields an abundant crop every year.

As a result of persevering effort, N. V. Zaitsev, a Michurinist experimenter in Malaya Vishera, Novgorod region, successfully solved the task of moving grapes to his region. The Michurin varieties that he raised give rich yields. An experimental station has been set up on the basis of his work.

In his articles in the newspapers Michurin repeatedly called the attention of the Soviet people, especially of

teachers, to the necessity of enlisting the services of schoolchildren for experimental plant growing. He attached tremendous importance to the dissemination among school pupils of a rudimentary knowledge of selection of agricultural plants. Michurin recommended the organization of juvenile expeditions to search for new plants. He pointed to the wisdom of getting children interested in collecting the seeds of fruit, vegetable, industrial and arboreous plants, and herbs.

A mighty movement of Young Michurinists has been set in motion in the U.S.S.R. under the leadership of the Komsomol, and it now embraces some ten million schoolchildren. Boys and girls participate in the work of planting greenery in the towns, and laying out orchards and flower beds around school buildings, hospitals, and kindergartens.

All his life Michurin strove to make his scientific discoveries and methods widely adopted in practice. Michurin recognized the right of science to call itself a science only when it serves and is organically bound with practical work.

He wrote: "I consider it my greatest duty to caution all those working in the field of fruit and berry growing that however great their successes and however bright the prospects of the work, there always exists the hidden danger of theory being divorced from practice."

* * *

Michurin's teaching is not only a theory on the life of fruit and berry plants: it is a general biological teaching applicable to all plant growing and animal husbandry.

Michurin's work is being furthered and developed by a whole army of Soviet biologists headed by Academician T. D. Lysenko, an outstanding scientist who has devel-

oped Michurin's teaching by proving the non-existence of intraspecific struggle. Lysenko worked out the theory of phasic development which is the most important discovery in plant physiology and is of tremendous significance in raising the yield of agricultural plants. On the basis of the theory of phasic development, Lysenko solved the major national economic problem of combating the degeneration of the potato in the south.

He likewise found new ways of selecting parental forms of plants for interbreeding in order to obtain new varieties as quickly as possible; he discovered why plants differ in winter-hardiness, thus making it possible to rationalize measures of preventing winter crops from perishing. Lysenko is effectively solving the highly important national economic task of cultivating winter wheat in Siberia where it was not grown before. On the basis of the theory of phasic development, Lysenko solved the equally important national economic task of sowing cotton in the North Caucasus and in the Ukraine.

Michurin's followers, by applying his effective teaching, are producing hundreds of new varieties of wheat, rye, barley, potato, and fruit and other plants.

The new varieties of spring and winter wheat—Lutescens 1163, Odesskaya 13, Odesskaya 3, and Odesskaya 12; and of rye—Omsk, Volzhanka, Udinskaya, and other varieties—originated by Academician Lysenko and his followers have better frost-resisting and yield capacities than the best old varieties and they are now sown on a large acreage in collective and state farms.

Of great scientific and practical interest is Academician Lysenko's work on branched wheat which is comprehensively studied at the experimental station of the Lenin Academy of Agriculture (near Moscow) and in many other parts of the country.

The Odessky 1 variety of cotton, which is now the staple variety for all the new cotton growing areas, has

been raised under Lysenko's guidance on the basis of Michurin's teaching. While prior to the Great October Socialist Revolution cotton was cultivated in small quantities only in Central Asia and Transcaucasia, large areas are now planted to this culture. Cotton cultivation has spread today from the Uzbek, Armenian, and Azerbaijan Soviet Socialist Republics to the North Caucasus, the Ukraine (Crimean, Odessa and Dniepropetrovsk regions) and even to the Stalingrad region. All this means that a stable source of raw materials has been established for our textile industry.

Let us take the tea industry. Before the Great October Socialist Revolution our country depended on imported tea, paying for it in gold. At present, owing to the correct application of Michurinist agrobiology, the Soviet tea-growing industry has developed tremendously. High-grade varieties of tea cultivated in Georgia, Azerbaijan, and in the Kuban region have liberated our country from the dependence on foreign imports.

Michurinist biology has opened the way to the north for vegetable and melon crops. In the last few years plant breeding stations have raised new early-ripening varieties of watermelons, musk melons, and tomatoes. These new varieties mature easily in the open air in 90 days after sowing; it was only recently that the accepted northern boundary line for melons passed in the neighbourhood of Voronezh.

The teaching of the great remaker of nature is likewise being successfully applied in animal husbandry. It has been proved that directed training of young animals and proper selection, better keeping, feeding, and care make it possible to raise new breeds, to improve on the older ones, and to increase the productivity of all domestic animals and poultry.

Soviet scientists and Michurinist live-stock breeders have produced new, exceptionally valuable breeds of cat-

tle, such as the Kostroma breed. The yield of individual record-holding milch cows of this breed amounts to 15,000 or 16,000 litres in every lactation period. New breeds of sheep have been originated, and these include the Askania, Caucasian, and Siberian Ramboulier, which give a high yield of excellent wool. Some specimens of rams of this breed often weigh as much as 100 kilograms and more.

New breeds of highly productive pigs have likewise been raised; these are the Ukrainian White, North Siberian and other breeds which easily adapt themselves to local conditions.

Considerable successes have been achieved by Michurinist breeders in raising horses. They have produced the Vladimir breed of heavy draught-horses, the Budyonny breed of horses, and the Terek saddle horse that combines in itself the most valuable qualities of the Arab and English race horses. The Russian saddle horse as well as the old Bityug cart-horse, now known as the Voronezh carriage-horse, have been restored and perfected.

Applied in animal husbandry Michurin's teaching has produced excellent results. In the last ten years alone no less than twenty new native highly productive breeds of domestic animals have been raised in the U.S.S.R.

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The vital strength of Michurinist biology has been tested in the U.S.S.R. in practice on the boundless expanses of collective and state farms. Michurin moved fruit orchards far to the north and embellished them with new varieties. His teaching has spread over all the regions of the Soviet Union. It is guiding the work of Michurinist innovators, ardent patriots of our country, in the south and in the west, in the Far North, in the Urals, in Siberia, in the Far East, in the mountainous regions of

the North Caucasus and Transcaucasia, and in the mountains and plains of Central Asia. They are successfully producing new high-yielding varieties of agricultural plants and new highly productive breeds of domestic animals.

Progressive Soviet biology is a powerful instrument for further developing the whole of socialist agriculture.

The Soviet land is confidently marching forward along the road to communism. The Soviet people are faced with big tasks of rapidly furthering the development of agriculture, particularly of the cultivation of grain as the basis of all agricultural production. This new mighty upsurge of socialist agriculture and animal husbandry must secure in the next few years an abundance of foodstuffs for the population and raw materials for the light and food industries.

Wider cultivation of such valuable food as fruit, berries, and grapes is likewise of great importance for the creation of an abundance of foodstuffs. For that reason the raising on a big scale of the yields of orchards and vineyards, and the extension of areas planted under fruit and nuts is one of the most important problems to be tackled by workers in socialist agriculture.

Michurinist agrobiological science will play a big role in the fulfillment of this work.